THE SKY MOVIES

By GAYLORD JOHNSON

THE STAR PEOPLE

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BY

GAYLORD JOHNSON

AUTHOR OF "THE STAR PEOPLE"

WITH OVER ONE HUNDRED PICTURES

"I see a great round wonder rolling through space,
. . . . . .
I see the shaded part on one side where the sleepers are sleeping,
and the sunlit part on the other side,
I see the curious and rapid change of the light and the shade,
I see distant lands, as real and near to the inhabitants of them as
my land is to me."

Walt Whitman: Salut au Monde.

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TO "SAINT ELIZABETH"

We tell children things in the clearest words at our command. They say the words back to us and we are satisfied that they have learned something. We think that because they have the words they have the idea. A little investigation will show that very often the words are all they have, the sounds, and nothing whatever of the idea.

So, whenever you teach a child something new, be sure to tie the stranger to an old familiar friend. If that does not seem possible, use pictures and drawings and illustrations until the child has a group of related ideas concerning this new idea. Then let him talk it back, making his meaning clear by word and gesture and drawing.

Beware the empty word!

ANGELO PATRI.

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THE SKY MOVIES

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FIRST REEL

IN WHICH THE CHILDREN UNEXPECTEDLY MEET MR. PUCK IN GRANDFATHER'S STUMP MEADOW—AND LEARN WHY FAIRY RINGS ARE NEEDED IN THE WORLD

IN the twilight of that June evening when the Young Moon was a thin bent bow in the West, she looked across Grandfather's Woods and saw three children come out from the dusky trees. Then she watched them start across Grandfather's Stump Meadow toward the farm house, where a light was already shining in the kitchen window.

Peter and Paul, the twin boys, were ahead, and Betty, their sister, brought up the rear.

Suddenly the Young Moon saw the three stop, and, if her hearing is good, she may have heard their high-pitched exclamations of delighted surprise at what they saw.

"O, look!" cried Paul, "a reg'lar circus ring of toad-stools!"

"There's 'most a million!" exclaimed Peter, "at least, 'most a hundred—or fifty!"

"Ooo! it's a Fairy Ring!" breathed Betty in a loud stage-whisper, while she looked expectantly through

the gathering dusk for any of the Little People who might be about.

Not seeing any, however, she confided to Peter and Paul,

"Uncle Henry told me to watch for a Fairy Ring when we got up here at Grandpa's. Uncle Henry says that if you stand in a Fairy Ring, and wish and wish, awful hard, to truly know all 'bout everything that you want to know 'bout, that you *will* know."

"Humph!" said Peter, with the disdain of eleven years for the credulity of eight.

"Well, I guess Uncle Henry ought to know," insisted Betty, "he says he used to do it—right up here at Grandpa's—maybe in this very ring—and I guess *you* won't dare to say, Mr. Peter, that Uncle Henry don't know a lot—most likely a million times more 'an *you* do!"

Under this heavy gust of woman's logic Peter bent like a grass stem in the breeze.

"Well," he countered, "if you believe all that's true, why don't you just step into this good old ring of toadstools right now—and wish hard to know something? An' then we'll *see* who's right about it. Maybe Uncle Henry *is* right," Peter finished, leaving a wide opening for his own escape, in case the toadstool ring proved to have magic powers after all.

"Sure," agreed Paul, "think of something you wanta know, Betty, an' then get in the ring an' *wish* to know it, an' then we'll *see* if Uncle Henry is right. Mos' likely he is," Paul conceded in advance.

After a short pause he added impressively,

"He is *generally* sure of his facks."

The others turned to Paul and looked at him so disapprovingly after this last remark that he knew they had detected his bold theft from Papa's collection of favorite phrases.

"Go on, Betty," urged Peter. "Wish to know something quick an' step inside the ring! We can't stay out here after it gets real dark, an' you may not find out what you wish to know all at once."

Betty looked across Grandfather's Woods, toward the slim, brightening bow of the Young Lady Moon, and said,

"All right—I wish—I want to know—what makes the lovely Lady Moon grow bigger, full, and thin again every month."

Then, while the twin boys held their breaths in half-scared expectancy, Betty stepped confidently into the wide, grassy, magic circle of dim white umbrellas, into the enchanted Fairy Ring, and stood—waiting in simple faith for her beloved Uncle Henry's prophecy to be fulfilled.

The boys gazed silently for a full minute, looking first at Betty and then at the Young Lady Moon. Nothing happened. Then they heard Betty murmur,

"I've always wondered about you, Lady Moon—I'm wondering now—why you're slim—and why you grow full—and why—"

She stopped, startled, half afraid, for from the edge of Grandfather's Woods there came a sudden, soft whirring like the humming of bees in the apple

orchard in blossom time—and out of one of the dim, velvety spaces between the trees poured a glimmering swarm of fireflies.

Straight across the Stump Meadow toward the Fairy Ring they came—while the whirring grew louder, and the soft gleams grew brighter.

Three times round the heads of the bewildered children the swarm of fireflies flew—and three times they circled a low stump just inside the Fairy Ring—then back for Grandfather's Woods—like a flight of tiny illuminated aeroplanes.

The children were all gazing open-mouthed after them when they heard the merriest little laugh—and it seemed to come from almost under their feet!

Peter and Paul looked right and left, and turned round and looked, without seeing anything—but Betty clapped her hands and cried,

"Oh, I see him! In a green suit! On the stump, Peter! Look on the stump, Paul!"

Peter and Paul did, and rubbed their eyes and looked again, but not a thing could they see—except a pad of green moss in a damp hole in the flat top of the stump.

But in a moment they heard the merry, tinkling little laugh again and again—and after it a gasp for breath—as if the laugher's sides fairly ached with his explosion of merriment.

Then, between gasps, came words,

"Tell—tell yon naughty ones—tell Petrus and Paulus—to step in the Ring. They will see naught—

of me or truth—except in Wonder Ring. Step inside!—Step inside!"

Peter and Paul did—and as soon as they crossed the magic circle of ivory-white umbrellas they saw what Betty had said—a tiny elf-like man—all in a green suit—with long, green hose, and green shoes with long points.

His plump-cheeked, red face was seamed and wrinkled like a sound apple that dries and shrinks small, and his eyes were pale blue like a baby's.

When he laughed, his mouth was as wide as his ears, but at other times it was as pursed and puckered as Grandfather's tobacco pouch when the drawstrings are tight, and from his green hood strayed wisps of sun-bleached hair.

Betty's first thought, after her suprise at seeing him at all, was a desire to have the little foot-high manlet for a doll.

"Ods me!" cried Puck, for it was he *himself*, none other, "they see *now*—aye, they see *now*! Ha, ha! Ha, ha, ha! Aye, but they are the naughty ones yon!"

"*Why* are they naughty, please, Mr.—Mr.—sir?" inquired Betty, after a moment's hesitation.

"He, he, he! ha, ha, ha!" rattled the little green man's wide-mouthed laugh. He sounded for all the world like a good-natured squirrel chattering from a tree. Then he puckered his tobacco-pouch lips and solemnly winked one sparkling blue eye at Paul and the other at Peter before he said mockingly,

"*Maybe* Uncle Henry *is* right—Most *likely* he *is*—
He is *generally* sure of his facks. Ha, ha, ha, ha, ha!"

"My, aren't we sassy for our size!" exclaimed Paul, half angry at the mockery.

"The Lady Luna Moon," stated Puck, capriciously changing the subject, as he looked over his shoulder toward the West, "has bought her ticket for China. It's a round-trip one though. She'll be back—with Columbus or Magellan—probably with both," he finished solemnly, quite as if he expected it to happen and wouldn't have been surprised to see Columbus right there in the Stump Meadow.

"I like you," said Betty impulsively, "but you certainly talk so—so—well, I mean—"

Betty had started to say something quite impolite, and didn't quite know how to finish.

"Ods me!" cried Puck, "first you stand in a Fairy Ring, and *wonder* about Lady Luna—and then think I'm daft when I come! I know well I'm not crazy—I'm the Answer—the Answer to your 'wondering'—the slave of every Fairy Wonder Ring in the wide world's meadows— I'm *The Joy of Finding Out Things.* I sat on Columbus' shoulder when he saw the New World's land; I took the first peep through his new telescope with Galileo; I watched with Edison, while his first electric light bulb glowed, then brightened and shone.

"*They* were all called crazy too, but they didn't care, for they had me—the Answer to their wonderings—*The Joy of Finding Out Something New.*"

"Please Mr.—ah—sir—" began Betty.

"Call me Puck—t'will do," said the little man in green.

"Please, then, Mr. Puck, did Mr. Edison stand in a Fairy Ring and ask to know about the electric light?"

"Certainly, whether he knew it or not!" cried Puck. "No answer ever comes to the wonderings of man or child—except in a Fairy Ring! That's why men who delight to walk much in the fields to think are the ones who so often find out marvellous new things. It's because—sooner or later—they walk into a Fairy Ring—a Wonder Ring—and the Answer to all their wondering comes to them there."

"Then tell *me*, please, Mr. Puck," said Betty, "what *I* wondered about—why the Lady Luna Moon is thin, and grows full, and thin again, all in one month."

"Oh, ho!" cried Puck, "the little lady wants to know all—like that."

He snapped his fingers, winked one blue eye and then the other, and went on,

"If you can tell *me*, little lady, only one thing I will ask you about Luna Moon, I will tell *you* all you desire to know of her."

"All right," said Betty, a little disappointed to find that she had to give answers as well as get them in Wonder Rings, "I'll *try* to tell you—if I know."

"Here it is," said Puck. "What does the Lady Luna Moon always hunt, with her bent bow?"

Betty thought and thought, and so did Peter and

Paul, while Puck sat cross-legged on his stump and whistled a strange old tune through his lips, pursed now like Grandfather's pouch.

At last Puck stood up, hopped down among the cowslips that splashed the soft sod with gold, and said,

"Tell me what it is the Lady Luna hunts—on tomorrow's eve—here in the Ring—and I will be here to tell you more. Petrus, bring a lantern; Paulus, thy fresh-shaved round head; little lady, the white ball thy dog runs after. To-morrow's eve—in the Ring."

Then Puck stepped across the edge of the mushroom ring and was gone. One second he was there, clad in green—and the next there was nothing there—except grass and cowslips.

"This sure is a Wonder Ring, all right!" cried Peter. "He makes us wonder *more*, instead of less."

"What *can* he want with a lantern—and 'Rags'' ball, and my head?" mused Paul, as the children trudged toward the welcoming light in Grandmother's kitchen window.

Betty said nothing. She was thoughtfully watching Luna Moon's bent bow as it sank in the sky beyond Grandfather's Woods—after the vanished sun.

She was still trying to guess the answer to Puck's riddle when she fell asleep in the little room under the eaves, where the ceiling slanted just like the roof, and the big bed made it seem a long time until one would be really grown up.

SECOND REEL

IN WHICH GRANDFATHER AND GRANDMOTHER GIVE WRONG ANSWERS TO PUCK'S RIDDLE BECAUSE THEY DON'T KNOW THE REAL ONE—AND THE HIRED MAN, OTTO, STEERS THE CHILDREN RIGHT WITHOUT KNOWING IT

NEXT morning Betty and her brothers "interviewed" everybody on Grandpa's farm, and no one was permitted to escape until he had told all he knew about Luna Moon and her bent bow.

Betty began with Grandpa himself. The "committee of inquiry" raced out to the barn where he was cleaning a harness, and Betty walked up to him with an air of such serious purpose that Grandpa said, with an alarmed look on his face,

"I'm the man you're looking for, Miss Sheriff. I'm Captain Kidd, miss; you'll find the treasure chest of 'pieces of eight' buried under the third apple tree in the second row from the barn. Take it and spare my life. I'll never run up the 'Skull and Bones' at the mast head of a ship again, so help me Davy Jones!"

At this Betty laughed gleefully, and the boys took the harness away from Grandpa and made him sit down on the edge of the watering trough.

Then Betty said, quite as regally as good Queen Bess might have done to the real Captain Kidd, if they had happened to live at the same time, and if they had happened to be socially acquainted, and if Captain Kidd had happened to ask such a little favor of her, say while they were drinking tea together,

"All right, Captain, your life is spared—on one condition. We want to know what it is that the Lady Luna Moon always hunts and shoots arrows at with her bent bow. Tell me that, Captain Kidd, or you shall walk the plank and swing from a yard-arm."

"Both? Then I'll tell you all I know, Madam Sheriff," said Grandpa seriously. "My grandpa told *me*, and he *knew*. You see it's like this. When the young moon's bow lies on its back, with the horns up, so that the old Indian Ossawatomie can hang his rifle and powder horn on them, it is going to be a *wet* month, and the old Indian Ossawatomie will stay home from hunting. But if the young crescent moon stands up on one horn, so that the rifle and powder horn would slip off, why it's going to be a *dry* month and Ossawatomie will be able to go hunting. Now please, Miss Sheriff, I'd like to finish cleaning that harness."

"I guess," said Peter slowly, "that we'll have to get that plank ready for Captain Kidd to walk after all."

"Don't you really know what Luna Moon shoots her arrows at?" asked Betty disappointedly.

Grandpa only shook his head slowly and sadly

and begged to be given until sunset to live, in order to go to town with a load of hay and play one more game of checkers on his return. So the "committee of inquiry" went in search of Grandma.

She was in the kitchen "stirring up a cake," but as soon as the oven door was closed upon it she walked over to the calendar on the kitchen wall and tried to answer Betty's question about Luna Moon.

"You see, dearie," said Grandma, "the moon looks like this when it's in the 'first quarter.'"

Grandma pointed to this picture of it on the calendar.

Then she pointed to the next moon-picture on the calendar and said,

"And when the moon is in the 'last quarter' it curves the other way. You see the *first* quarter of

the moon in the *West* just after sunset. I saw it last evening. But you see the *last* quarter in the *Eastern* sky just before sunrise. You will see it there in about a month from now."

"I never noticed that!" exclaimed Paul.

"I didn't either," said Betty.

"I always say that people who live in cities," said Grandma, "miss the best part of the day. They never see anything that happens in the world before eight o'clock."

Betty looked from the 'first quarter' picture of the moon on the calendar to the 'last quarter' picture, and back again.

"Seems as if we *ought* to understand it now," she said, "but I don't. Do you?" she asked, turning brightly to Peter and Paul.

They shook their heads and looked expectantly at Grandma. She tried hard to rise to the emergency.

"You see, children," she said, "when the first quarter of the moon lies on its *back*, with the horns straight up, so that the water in it can't run out of the horns, why then it's going to be a *dry* month; but when the first quarter stands up on one end, like it is in the calendar picture, then the water in the moon *can* run out, and it will be a *wet* month. My father, your great-grandpa Bassett, told me that when I was no higher than a chair, and I've never seen it fail," finished Grandma.

The children were puzzled; they looked at each other, and then at their smiling Grandmother. In a

moment Peter's eyes narrowed in a roguish way they had, and he said, "I wonder, did great-grandpa Bassett know Ossawatomie?"

Then something strange happened. Grandma actually blushed red in her cheeks, laughed, and shoved the "committee of inquiry" out of the kitchen. She asked Peter how he thought she was going to get the kitchen work done before noon, with three live question marks standing around.

Betty was the last one out of the room, for she stopped to slip her hand into the big cooky-jar in passing, and she heard Grandma murmur to herself, "Imagine his telling those children that old Indian nonsense!"

Either Grandpa or Grandma must be wrong about the way Luna Moon's bow tipped when it was going to be wet weather. They just couldn't *both* be right— and neither of them had given Betty the answer to Mr. Puck's riddle.

The next witness examined by the "committee of inquiry" was Otto, Grandpa's hired man. The children found him cultivating the hills of young corn with "Molly" and "Jerry."

Otto stopped the team at the end of a row and listened attentively to Betty's question about what Luna Moon shoots her arrows at.

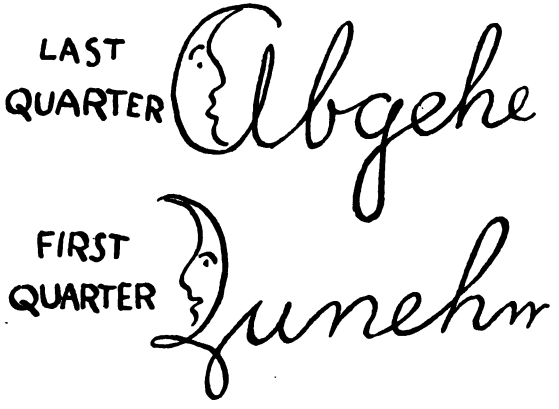
Then Otto twisted his faded, straw-colored mustache a moment, while his blue eyes looked off across the field. They seemed to be looking clear across the ocean to Otto's "native place."

"I remember," said Otto, "my old schoolmaster,

ven I go to school in Steinplatz, tell me that. I show you."

Then Otto took the butt end of his whip and wrote these two German words in the soft cultivated dirt of the cornfield:

Then Otto changed the curves of the letter A and Z to look like this and wrote "last quarter" and "first quarter" opposite each moon picture.



"Oh, I see!" cried Betty, "What do the German words mean, Otto? Do they mean 'first quarter' and 'last quarter?'"

"No, no," said Otto, "I will show you. '*Abgehen*' means 'going avay' and '*Zunehmen*' means 'increasing.' You see the first quarter moon is 'increasing' toward being full; and the last quarter moon is 'going avay' from being full. The letters are bent the same vay like the moon's bows—vun vun vay and vun the odder. You see it now!" Otto decided, as he picked up the reins and clucked to "Molly" and "Jerry."

The children were still looking at Otto's drawings in the dirt when Paul suddenly cried,

"Oh, listen! I think I got the answer—to Puck's conundrum!"

"Shoot!" said Peter.

"It's like this," said Paul. "Luna Moon's first quarter bow aims down toward the sunset in the West in the evening.

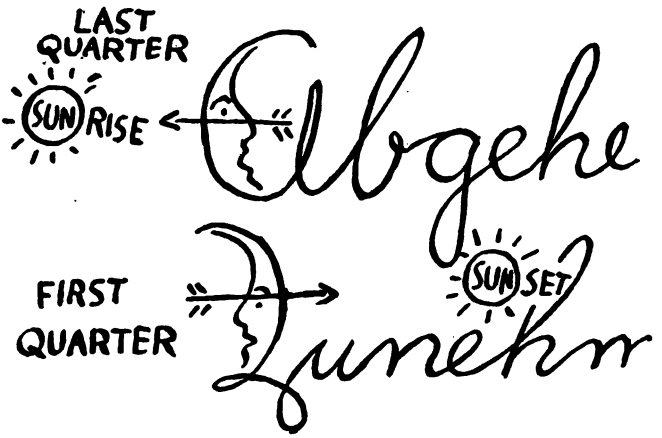
"Yes," said Peter.

"Well," Paul went on excitedly, "and her last quarter bow aims down toward the sunrise in the East in the morning, doesn't it?"

"Sure," said Peter, "we know that a'ready."

"Well, "said Paul, "just let's draw arrows into Otto's moon-bows—and then put 'suns' in—one for the sunset-sun and 'nother for the sunrise-sun, and I bet we'll see what Puck meant!"

Paul quickly did it, and Otto's artistic efforts looked like this:



"Oh, I see!" cried Peter and Betty together, while they each gave Paul a look which proved that a prophet *can* have honor in his own country.

"Oh," exclaimed Betty, "the Lady Luna Moon always hunts the *sun* with her bent bow. The *sun!* That's what we'll tell Puck this evening. We've got the answer. The *sun!*"

Just then the breeze shook the branches of one of the apple trees at the edge of the cornfield, and something dropped lightly on Paul's head and bounded to the ground between the children.

They thought it was a small, green baby apple, when, of a sudden, Puck's squirrel-like, chattering laugh came up from under their very feet. It was really Puck, quite plainly to be seen, in spite of the fact that the children were not in the Fairy Ring at all.

"Where *did* you come from?" cried Betty. "Oh, how you scared me!"

"I brought the right answer," piped the little green man with the puckery face. "The right answer shouldn't frighten anybody. The only time when terrible things begin to happen is when you say 'twice seven is sixteen.'"

Puck pursed his tobacco-pouch lips, winked one blue, sparkling eye at Peter and the other at Paul, and suddenly sprang straight upward, landing on his feet, like a bird, upon a low-hanging twig of the apple tree. Then he sat down on the thin twig, as expertly as tight-wire walkers do in the circus, began to sway to and fro in the breeze, and started to talk in his pipy little voice.

"Mr. Dexter R. Optick," began Puck, "lives in the valley just to the West of Nose Hill—and Mr. Sinister L. Optick, his brother, lives Eastward, in the valley just over the hill."

"Are they brothers, Mr. Puck?" inquired Peter.

"Aye, twin brothers," said Puck, "but neither has ever seen the other."

"How funny!" shrilled Betty. "Haven't they *ever* seen each other?"

"Well," said Puck, "*hardly* ever. Only by hearsay, or rather mirror-say. Mr. Dexter R. Optick sees everything that goes on to the West of Nose Hill, and Mr. Sinister L. Optick can tell you all the matters that happen to the East of it, but when it comes to knowing each others' doings, they just

have to believe what Looking-Glass, the Gossip, tells them, or be ignorant."

This picture shows you which sides of Nose Hill Mr. Dexter R. and Mr. Sinister L. Optick live on. When you know that, you'll probably be able to guess what their middle names are.

Puck suddenly stopped talking, and seemed to be listening intently. Then he stood up on the twig and began to jounce it up and down, as a bather does the springboard before he dives.

"I'm off!" cried Puck, teetering violently, "I'm the slave of Fairy Wonder Rings everywhere, you know, just like Aladdin's Genie of the Lamp. A

little boy in California has just walked into a Ring—and he's wondering why bees go into flowers—so he'll need me in a few minutes. See you in the Stump-Meadow after supper! I'm off!" cried Puck again—as his springboard twig threw him up into the air. That was the last the children saw of him that afternoon.

THIRD REEL

WHY THE PRINCESS ISTAR LOSES AND GAINS HER JEWELLED ROBES—AND MORE ABOUT THE OPTICK BROTHERS AND WHAT THEY LEARNED OF LUNA MOON

THE children, and Betty particularly, could hardly wait until evening to tell Puck the answer to the riddle of Luna Moon's bow.

"I bet that he knows a'ready that we guessed it all by ourselves," said Paul, as the three walked across the Stump Meadow toward the Fairy Ring after supper. "I sort of *felt* him around when I was drawing the arrows into Otto's first and last quarter bows."

"Well," said Peter, "he promised Betty to tell her anything she wanted to know 'bout Luna, if she could just answer the riddle to-night, so I guess it won't make any difference whether he knows we found out all by ourselves or not."

"Otto helped," said Betty. "We shouldn't have guessed it if Otto hadn't helped."

The Young Moon's crescent was shining clearly in the last of the sunset glow as the children arrived at the Wonder Ring. Luna was not quite so slender as on the previous evening, and her bent bow was seen higher in the sky as the glow faded.

"Last night," said Paul, "the lady's bow was right close to that bright evening star, and to-night the bow is away up above the star. I wonder why?"

"I'll ask Puck," Betty promised him.

Just then the children reached the Ring, Peter carrying the lantern, Betty 'Rags'' white rubber ball, and Paul his own head. All were full of curiosity as to what Mr. Puck could possibly want with these three objects.

When the children were still outside the Fairy Ring they saw nothing of Puck in or out of it, but the moment they had crossed its magic edge there he was, sitting cross-legged on the mossy stump. His eyes were wide, like those of a sleepwalker, his lips were moving, and he stared dreamily at the moon. He seemed not to notice the arrival of the children and talked to himself, half aloud, in a strange language that they knew was neither French nor German.

Now and then Puck spoke the word "*Istar*" as if he loved its very sound, and when he did this he bowed his head down between his knees and stretched his arms out straight before him.

Betty put her lips close to Paul's ear and whispered "He must be praying to the moon."

Puck sat up straight and turned toward the children. He gazed at them steadily for a moment and the far-away look went out of his eyes.

"Petrus," he finally said, "canst tell me what is the *Taj Mahal?*"

Paul hesitated.

"I like the sound of it," he said, "it sounds like some of the words in Mr. Kipling's stories of *Mowgli*, or *Kim*. It makes me see pictures of elephants with embroidered blankets, and howdahs on their backs."

"Right thou art, Paulus," said Puck softly. "The *Taj Mahal* is the jewel of India; a building of frozen dreams, and music and moonshine. My spirit was but now sitting before it, making my obeisance to the daughter of the Moon Goddess—to *Istar*—beautiful Moon Princess."

Puck's eyes became dreamy again. He sat quiet and seemed to have forgotten the children, and when he began to speak again it was half to himself:

"When the world was young; when the world was small; when the Great Pyramid was yet an unborn dream—then was *Istar* great in India. She was great—and the fame of the shining, jewelled beauty of the Moon Goddess' daughter came even to the Underworld below the sunset—to the ears of the mighty God of the Dead.

"And the Lord of that Underworld, living always in dim shade, made his demand that the daughter of the Moon Goddess visit his realm once every month—and since his power was great, it was so. Even to this day *Istar* must go to the Land of the Dead, once every month.

"From the heights of the sky she starts—just after the full of the moon—and each day *Istar* passes through one of the gates of Day and Night, on her way to the Land of the Dead.

"Each time she passes through one of the dim portals some part of her joyous, pearly robes is taken away by the Moon Goddess, her mother, and in its place a mourning veil of smoky dullness is draped about her form.

"Day after day she passes the portals that lead to the Underworld, and day after day her bright dress grows less and her dull robes cover her more completely, for the Moon Goddess is determined that the Lord of the Dead shall never see *Istar's* face and form in its beauty.

"And so it comes to be that when *Istar* passes the last portal, and enters the country of the shades, she is all in black from face to feet.

"It is no marvel that the King of the Dark sees no beauty in her veiled face and form and soon gives her leave to start her return journey.

"It is then that the Moon Goddess, her mother, begins to rejoice. From the Isles of the Blessed, where the Gods live, she runs singing to meet *Istar*, carrying with her the joyous, pearly robes of gauzy moonshine.

"At the first portal of Day and Night she meets her child, in rapture takes away some part of the veils of gloom, and in its place clothes *Istar's* body in the garments of woven light.

"At each portal that *Istar* passes through, her mother replaces with robes of light the heavy veils of her darkness, until once again *Istar*, the Moon Princess, mounts her throne in high-heaven—and from radiant hair to white-shod feet she shines in

the full, exquisite beauty that is the chief joy of the gods in Nirvana, the seventh heaven."

The children were quiet for some time after Puck had finished the story of *Istar*.

Then Betty said,

"It's a lovely story. I wonder why it is that all the most beautiful stories aren't true."

"But they *are* true," cried Puck, suddenly losing all his dreaminess. "All the most beautiful stories are really true. That is why they are beautiful. When you really understand the truth of *Istar's* story—the truth *behind* it—you will see that it can't help being true."

"But how can we learn the truth behind it, Mr. Puck?" asked Peter.

"How didst learn the truth about Luna Moon's bow and what she is ever aiming at?" inquired Puck.

"Why—it—it—just *came* to us, when we thought about the drawings Otto made in the dirt," answered Peter.

"Right thou art!" said Puck. "The right answer *always* comes. Petrus has the lantern; the little lady the white ball; and Paulus his head. We will put them together—the right answer will come—and we shall know the truth of *Istar's* beautiful story."

"How do we start? Let's begin! That's dandy!" cried all the children at once.

Puck stood up on the stump, pursed his puckery lips and gave a long, shrill whistle. Then he called loudly,

"Dexter, oh Dexter Optick! Ah, there thou art, in Paulus' head—and over Nose Hill I see thy brother Sinister Optick. We shall need you both to learn truth."

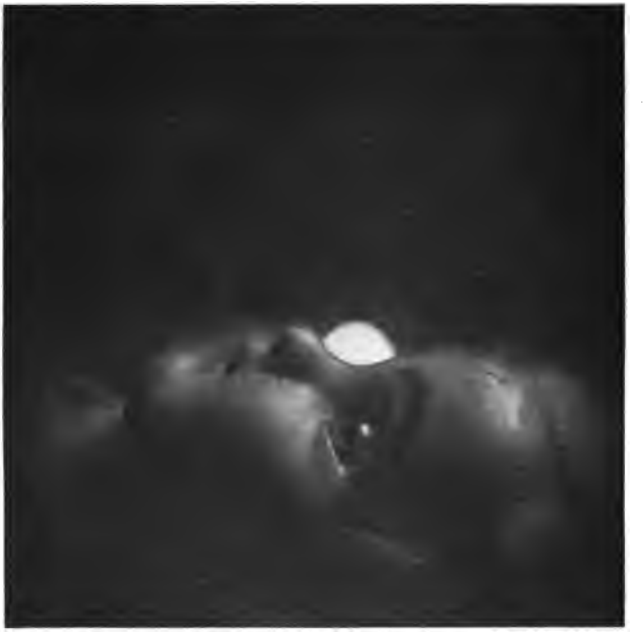
Then, at Puck's direction, Peter held the lantern upon the crown of his head; and Paul walked around Peter in a circle, as the earth moves round the sun; and Betty held up the white ball at the level of Paul's head, while walking around him as the moon moves around the earth.

The white ball in Betty's hand stood for the moon, and Paul's head stood for the earth, and the children looked like this in the gathering dusk.

You see that the lantern lighted only one side of the ball and Paul's head, just as the sunlight brightens only one side of the moon and the earth.

You see too how the Optick brothers, who live on opposite sides of Nose Hill, look out from the valleys of Paul's face, where they live, just as you do from your home on the earth.

When Paul's head turns from his right to his left, just as the earth turns on its axis from West to East, the lantern, or sun, goes down behind Nose Hill, like this:



The valley where Mr. Sinister L. Optick lives is already in shadow, but the setting sun still shines upon Mr. Dexter R. Optick's valley on the West side of Nose Hill.

If we could climb up a tree and look down on the top of Paul's head it would look like this—with the light from the setting sun-lantern shining on the West side of Nose Hill and Dexter Optick's home:

And if the moon-ball is in the position shown in this picture, just in direct line with the sun, neither Dexter nor Sinister Optick, nor anyone else on the earth, can see a bit of the bright half of the moon-ball—the side that the sun-lantern lights up. Then we say that the moon is "new."

"That's the time Grandpa calls 'the dark of the moon,'—the best time to plant things to make them grow, isn't it?" asked Betty.

"Yes," said Peter, "it's the 'dark of the moon' all right, but Grandma says it's the *worst* time to plant potatoes."

Puck looked from Betty to Peter, turning his head with the quick movements of a squirrel. Then he pursed his lips, gave a long, low whistle and said,

"What say the potatoes upon this weighty matter?"

None of the children had asked the potatoes.

"But I have," Puck assured them, "I have had speech with the potatoes—and I got one word, and only one, from them as to what time of the moon was best for them to grow in. One and all, the potatoes answered with the same word, and it was, 'Mumbo-Jumbo.'"

The children all gave Puck puzzled looks. "Mumbo-Jumbo" didn't sound like an answer to such a question at all. Finally Betty said,

"Please, Mr. Puck, can't you—will you—translate what the potatoes said—explain it a little bit?"

"Certainly," said Puck soberly, "it means that they all stood up and began to wrestle, catch as catch can, until the little red button on the cap of the Grand Panjandrum himself burst with a loud roar—and the gunpowder ran out of the toes of their boots."

"But, Mr. Puck," cried Betty, more puzzled than ever, "*that's* nothing but nonsense!"

"Of course!" Puck agreed with a bored air, "that's just what the potatoes said, and they ought to know—they do the growing."

"Come," he continued more brightly, "come

back into your positions again. We would wish to see with our eyes how *Istar* the Moon Princess looks, after her royal mother has met her at the first portal of Day and Night on her return from the Lord of the Dark."

The children took the positions they had before (when we imagined a tree, and climbed up it, and looked down and saw the top of Paul's head), like this:

As before, the moon-ball was directly in line with the sun-lantern and Paul's head, so that the Optick brothers could see only the moon-ball's dark side.

Then Betty, at Puck's direction, carried the white ball a little way along the curve of its circle around Paul's head, as you see in this picture.

After it moved, both the Optick brothers could see a little bit of the lighted side of the ball; and when they saw that the lighted part, just coming into sight, was thin and curved like the crescent moon beginning its first quarter, they told Paul and he cried in great excitement,

"Oh, Betty! I see now how Luna Moon gets her bow, and how it gets wider and wider, until the moon is full!"

The picture you have just looked at shows how the moon-ball would have looked if you could have viewed it from above Paul's head, and the next picture shows how the Optick brothers saw it at the same time, from the valleys where they live.

You see that it looks just the same as the moon does to you from your home on the earth at sunset time, when Luna Moon is a couple of days beyond her "new moon" position.

"Ooo!" cried Betty impatiently, "I want to have my Optick brothers see too!"

So Betty took Paul's place while Paul held the ball, and after that Peter had his turn.

Then Puck had Betty keep on moving the moon-ball around Paul's head until the Optick brothers had seen it go through all its changes or "phases"—"new moon," "waxing crescent," "first quarter," "gibbous moon," "full moon," "gibbous moon" again, "last quarter," "waning crescent," and back to the "new" or "dark of the moon."

The moving-picture play on the following pages shows just how Paul's head and the moon-ball looked from above; how the moon-ball looked to the Optick brothers at each stage of its trip around Paul's head, from "new" moon to "full" moon, and back again to "new" moon; and how the real moon looks at each of its changes through a month.

Next time you see Luna Moon's thin bow in the West, just after sunset, imagine you are Dexter or Sinister Optick, living beside Nose Hill on Paul's head, and imagine that you see the moon-ball, in the light of the sun-lantern.

Then watch Luna Moon go through all her phases night after night for a month, still imagining that you are one of the Optick brothers looking at the moon-ball, and you will understand how the moon waxes and wanes just as well as Betty and her brothers understood it.

After you have done that, you are sure to say, just as Betty did,

'I'm *terribly* glad all the beautiful stories are true too!"


The Sky Movies Presents
"Jack and Jill
in the Moon"
Continuous from
January to December

HOW TO EXHIBIT THIS "MOVIE"

Hold the book in the hands as shown in the picture below. Then, as the pages under your right thumb are rapidly released, one by one, you will see:

—how the moon waxes and wanes
—how it goes around the earth every month
—how the Optick Brothers see the moon's changes
—and how "Jack and Jill in the moon" go up the hill and down again.

Run the movie through several times and have fun watching something different each time.

See "Jack and Jill in the Moon?"

Of course there is nobody who doesn't know the man up there—and 'most everybody can see the lady—but how many know how to see Jack and Jill in the moon?

They are there—really they are—and these two little pictures will help you to see them. The first picture is a photograph taken by an astronomer at the great Yerkes observatory. Perhaps he didn't suspect that Jack and Jill were going to get into the picture too—but there they are.

"Jack and Jill went up the hill,
To get a pail of water;
Jack fell down and broke his crown,
And Jill came tumbling after."

NOW that you know how to see Jack and Jill in the moon, you can actually watch them do all the things the nursery rhyme tells about.

The sky is the "hill," and since the waxing moon is seen higher in the sky every night you can see how the moon children climb the hill of the sky too.

Then, as the moon wanes, Jack's curving side or "crown" of it gradually gets "broken" and dark and soon Jack himself has "fallen" out of sight.

After that it isn't but two or three days until Jill has "tumbled after" him—and there is nothing left of the moon itself but a narrow crescent in the East before sunrise.

How about the pail of water Jack and Jill went up the hill to get?

Well, don't you often hear people say,

"It will rain when the moon changes"—or, "After the moon is full there will be a storm?"

Of course, the rain doesn't always wait for Jack and Jill in the moon to tumble down and spill their pail-ful of it over us, but lots of

people still believe that the moon controls the weather.

The story of Jack and Jill is a very, very old one. The first time it was told it was meant for a description of the way the moon waxed and waned, and seemed to bring down the water from the sky. Now most people have forgotten the original meaning, and the story of Jack and Jill is just repeated as a jolly nursery rhyme.

We say that Jack and Jill is a *nature myth.* That means a story that was made up in the beginning to describe something that keeps happening in Nature. The simple people of long ago explained the actions of the moon by telling about Jack and Jill. We explain them by understanding what really happens, as Puck and the children did in the "reel" of this book that you have just read.

WAXING CRESCENT

(Photograph by Mr. R. J. Wallace)

Optick Brothers see narrow crescent in West at sunset.

Moon's Age: 3¾ days.

Jack and Jill cannot be seen yet.

WAXING CRESCENT

Opticks see a wider bow, higher in the West at sunset.

Moon's Age: 5½ days.

Jack's feet begin to appear in center of crescent.

FIRST QUARTER

(Photograph by Mr. R. J. Wallace)

Opticks see the moon half-full in Southern sky at sunset.

Moon's Age: 6¼ days.

All of Jack's legs and part of his body can now be seen, and he has gone a long way up the "hill" (the sky).

FIRST QUARTER

Opticks see the moon a little farther toward the East at sunset.

Moon's Age: 7¼ days.

All of Jack's legs and body are now visible, and his head is coming into sight.

GIBBOUS * MOON

(Photograph by Mr. G. W. Ritchey)

Opticks see the moon more than half full farther toward the East at sunset.

Moon's Age: 9¾ days.

All of Jack, including his head, can now be seen. His right arm holds on to the pail in the center of the moon.

* "Gibbous" means having the bright part greater than a semi-circle or less than a full circle.

GIBBOUS MOON

(Photograph by Mr. R. J. Wallace)

Opticks see the moon still farther toward the East at sunset time.

Moon's Age: 11¾ days.

All of Jack is now in sight and nearly all of Jill, with the pail held between them. Jill takes more imagination to see than Jack does.

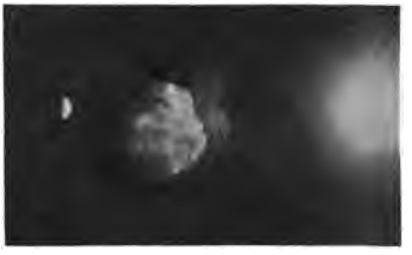
FULL MOON

(Photograph by Mr. F. Slocum)

Opticks see the full moon rise in the East at the same time that the sun is setting in the West.

Moon's Age: 14½ days

All of Jack and Jill are now in sight. They have climbed the hill of the sky as far as they can get away from the sun.



GIBBOUS MOON

(Photograph by Mr. G. W. Ritchey)

Opticks see the moon rise in the East after the sun has set.

Moon's Age: 18 days

Jack's curve or "crown" of the moon is badly "broken," and he is beginning to "fall down" out of sight.

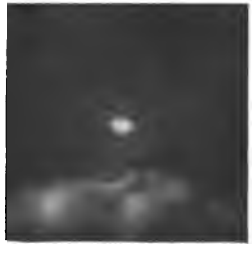
GIBBOUS MOON

(Photograph by Mr. G. W. Ritchey)

Opticks see the moon rise later in the evening.

Moon's Age: 20 days

Jack is nearly all gone except his head. Jill is getting ready to "tumble after" him.



LAST QUARTER

(Photograph by Mr. G. W. Ritchey)

Opticks see the moon rise still later at night.

Moon's Age: 20½ days.

Jill is just beginning to go "tumbling" after Jack down the hill of the sky.

WANING CRESCENT

(Photograph by Mr. R. J. Wallace)

Opticks see the moon rise very late in night and see it in the sky after sun-rise next morning.

Moon's Age: 24 days.

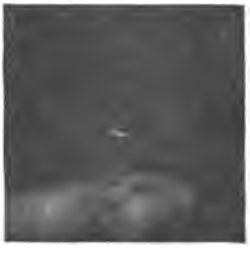
Jill is about all gone too.

WANING CRESCENT

Opticks see the moon rise only a little while before the sun does, and see it in the sky in the day time.

Moon's Age: $24\frac{7}{8}$ days.

Jack and Jill have now both t u m b l e d down the sky.



WANING CRESCENT

(Photograph by Mr. R. J. Wallace)

Opticks see the thin moon bow in the sky at dawn, while the sun is rising.

Moon's Age: 27 days

Jack and Jill are now getting ready to climb the hill of the sky again, after the time called "new moon," when the dark side is turned toward us, and nobody can see even a thin bow of light.

NOW LET US THANK THE ASTRONOMERS AND EVERYBODY ELSE WHO HELPED US

The wonderful pictures of the moon that you have just seen in our "Sky Movie" theater were shown by special permission of the Yerkes Observatory, and by arrangement with D. Appleton and Company, who used them in Mr. Garrett Serviss' book called, "The Moon."

Some of these photographs were taken with a twelve-inch telescope at the Yerkes Observatory, and some of them with the largest refracting telescope in the world, which is also there. There is a picture of this big Yerkes telescope on page 121.

We also wish to thank the director of this observatory for permission to show you the photographs of Venus, Mars and Saturn.

The fairy ring picture is used in our book by permission of the U. S. Department of Agriculture.

The picture of Jack and Jill, by Clara L. Burd, is printed by the courtesy of the Knapp Company.

The author is also indebted to the following books for facts, ideas and suggestions:

Todd: New Astronomy

Jacoby: Astronomy

Snyder: The World Machine

Fiske: Myths and Mythmakers

FOURTH REEL

IN WHICH THE CHILDREN LEARN .IIOW TO SEE THOUGHTS—JUST LIKE PICTURES—AND HOW MONSIEUR FOUCAULT PROVED THAT THE WORLD SPINS LIKE A TOP

WHEN the children had arrived at Grandfather's house from the Fairy Ring, after Mr. Puck had helped them to know the truth about *Istar*, the Moon Princess, they had a pleasant surprise.

Just as they had come into the barnyard with their lighted lantern, Grandfather had driven in, riding in his buggy, with "Molly" pulling it; and sitting beside Grandfather was Uncle Henry!

They could hardly wait for him to get out and get into the house, and see Grandmother, before they carried him off to the front porch and told him all about Puck and *Istar*, the Moon Princess.

Uncle Henry was very glad indeed to hear all about it, as they knew he would be, and he said,

"I was sure you'd get into a Wonder Ring, and I knew that just as soon as you did you'd find out some wonderful things and have lots of fun."

"Yes," said Betty, "and it was such fun! Puck is so cunning I can hardly bear to see him go when he disappears; he would make such a wonderful doll!"

Uncle Henry laughed.

"If you had Puck for a doll," he said, "he would be kept in a drawer and you'd always know just where he was—but now you never know just when or where he is going to appear. You just know he'll turn up and bring the right answer if you wonder and think enough, and that he'll appear when you least expect it. That makes him lots more interesting, doesn't it?"

The children all agreed that it did.

Then Peter said,

"Of course I know that it's true—because everybody says so, but how do people really *know* that our whole world turns clear around every day, the way the geography globe does on its iron axle-rod?

"The whole sky *seems* to turn around *us* and move over us from East to West. How did people prove for *sure* that it's really the earth turning the other way that makes the stars and sun and moon rise and move across and set?"

"Let's try and find out to-morrow," said Uncle Henry. "We'll go out and stand in the Fairy Ring and wonder real hard—and maybe Puck will bring the answer to us."

"All right," cried Betty, "let's!"

The boys agreed, so Uncle Henry went in and to bed, for he was tired from his trip from the city.

Next morning, however, the children carried him off to the Fairy Ring right after breakfast. Uncle Henry admired it very much—it was such a beau-

tiful, big one! If you have never seen one yourself this will be a good time to show you how they look.

Courtesy U. S. Dept. of Agriculture

Uncle Henry told the children that the little fairy umbrellas were not toadstools, as they thought, but mushrooms, so you may as well know too.

This isn't a picture of the very same ring in which Puck first appeared to Peter and Paul and Betty, but it is one just about like it, and since Puck is the slave of every Wonder Ring in the world he probably appeared in this very one in the picture some time or other.

Uncle Henry explained that Wonder Rings probably start from just a few mushrooms, perhaps only one. The seeds of the mushroom get scattered in a circle around it, and next year a circle of grown-up mushrooms appear. Then these in their turn scatter seeds over a wider circle, and these make grown-up mushrooms the next year, and so on.

Some Fairy Rings are supposed to be five or six hundred years old, so Puck must have been called to bring answers to them a great many times.

Uncle Henry and the children stepped into the Ring and wondered and wondered about how we can be sure that the earth really turns around, but nothing happened. Puck didn't appear at all.

Betty said,

"Maybe he's off in California again showing that boy some more about the bees and the flowers."

Uncle Henry thought not.

"Let's walk back to the barn," he said, "I have an idea that maybe we'll find him there."

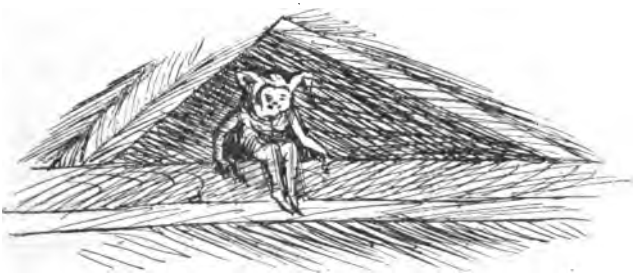
When the children and their Uncle came back

to the barn Uncle Henry said he felt sure that Puck must be hiding somewhere about, so the children started looking for him.

Betty turned over a rusty old tin pail that was upside down on the floor, but Puck wasn't under it. Paul looked under the seat of the buggy, but all he found was a coil of thin, smooth fence wire that Grandfather had brought from town the day before.

Just then all the children heard Puck's chattering, bubbling laugh—just the way they had heard it the first day they had seen the little green man on the stump. The laugh seemed to come from high over their heads, away up among the dim cobwebs under the roof.

When they all looked up they could see nothing at first, the light was so dim, but when their eyes got used to it they saw Puck sitting on a big beam that crossed the barn from side to side a few feet below the roof.



He looked down and said cheerily,

"Hello, Petrus and Paulus! Hello, little lady! Hello, Old One!" Uncle Henry was only twenty-

five, but that *is* rather old after all, and he didn't seem to mind being called "Old One" at all, so Puck never called Uncle Henry anything else after that.

"I'm sending down a spider on his own spider thread," Puck continued, "he'll be down in a minute. When he gets there, give the spider the end of a spool of cotton thread and he'll haul it back up here to me."

Betty rushed off to the house, and was back in a minute or two, after making a swift raid on Grandma's work-basket. By that time the spider had let himself down, all the way from the beam, on a tiny, silken cord of his own spinning.

You have seen spiders do this lots of times, and haul themselves back up to where they came down from afterwards too.

Well, when the spider was down within reach Uncle Henry unwound a lot of the fine cotton thread from Grandma's spool and gave the end of it to the spider, and back the clever insect went with it, climbing his own silken cord, up to Puck on the beam above.

Then, when Puck had taken the end of the cotton thread from the obliging spider, he braced his feet and got ready to pull hard, while Uncle Henry took Grandpa's coil of smooth wire out of the buggy box, made a wire loop in one end of it, and tied the thread onto it. Then Puck hauled and hauled on the thread, and up and up went the wire until the end of it was in Puck's hands.

It was only the work of a minute for him to wind the wire tightly around the beam and twist and tie its end firmly in place—and then Puck came sliding down the wire to the children on the barn floor.

Peter and Paul and Betty were thoroughly mystified now, and Peter said,

"What has all this got to do with the world turning round every day, Uncle Hen?"

"You'll see pretty soon, Pete," said Uncle Henry reassuringly. He was looking closely at the rusty old water pail and now he brought it over to the centre of the barn floor, where the wire hung down from the beam above.

"That's why Grandma threw it away," said Betty, putting her little finger through the hole in the middle of the pail's bottom.

"We can soon fix that," smiled Uncle Henry, "Pete, just step out and cut a strong, straight twig from one of the apple trees."

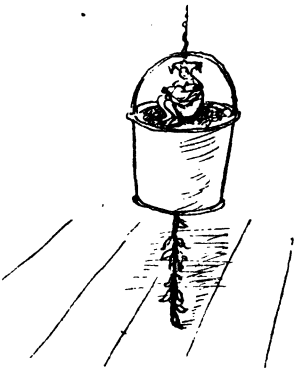
Peter ran to do it, and when he had brought a twig about a foot long Uncle Henry forced the cut end of the twig into the hole and made the pail so that it wouldn't leak. But instead of cutting off the end of the green stick below the pail's bottom, Uncle Henry left it sticking straight down.

The children's eyes were now popping out with curiosity and they opened wider still when Uncle Henry fastened the handle of the pail to the wire hanging from the beam and adjusted it so that the leaf at the end of the twig just brushed the boards of the barn floor, like this:

"Now, Paul," commanded Uncle Henry, "you and Pete bring a few shovelsful of moist earth from the garden and pack the pail with it until the dirt is level with its top."

The boys did this quickly, with Puck dancing impatiently around the hanging pail. The moment the earth was smoothed off level with the top Puck gave a leap and landed on the soil and pebbles in the pail.

Then it looked like this as it hung from the beam about forty feet above.



"Now," said Uncle Henry, "we'll rummage in the tool chest a minute and then go ahead. I want father's plumb-bob."

He found it after a search of a minute or two in the tool chest behind Molly's stall, tied a piece of string to the bob and to a foot rule, and handed it to Paul, who looked like this, as he held the rule in both hands.

"Now," said Uncle Henry, "I'm going to start the heavy plumb-bob swinging back and forth at right angles to the ruler. Then Paul will quickly turn the ruler so that it points straight out away from his hips instead of being parallel to them as it is now. Then all of you watch the plumb-bob and see what it does."

The bob was set swinging like the pendulum of a clock. It swung back between Paul's feet and then straight out away from him—back and forth—back and forth. Then Paul suddenly turned his hands so that they were in this position.

The ruler was now just at right angles to the position it was in before.

The children watched the plumb-bob closely.

"It isn't doing anything *different!*" cried Betty, "it just keeps on swinging back and forth between Paul's legs."

"No," said Uncle Henry, "the pendulum will keep on swinging in just the same direction it started, no matter how we turn the ruler it is hung from.

"Now suppose that we started the pail of dirt swinging on the wire that hangs from the roof beam up there, and then suppose that Paul was an immense giant, and could pick up this whole barn and suddenly turn it a quarter of the way round and set it down again."

The children did their best to suppose that Paul was a giant big enough to do it. These were the pictures they saw in their imaginations:

"Now," said Uncle Henry, "what would the swinging pail of dirt do while Giant Paul picked up the barn and turned it round?"

The children thought a moment and then Peter said,

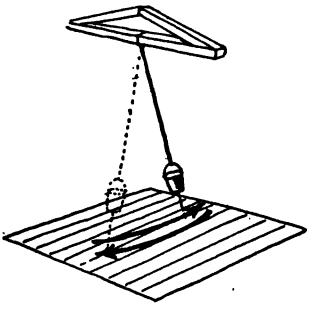
"I suppose it would keep on swinging in the same direction it started in—just like the plumb bob does."

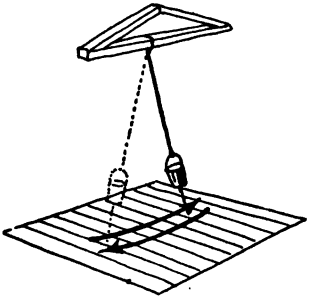
"Well then," Uncle Henry continued, "if the pail was swinging *lengthways* of the barn, along the line of the cracks between the floor boards, how would it be swinging after Giant Paul had turned the whole barn, floor and all, through a quarter of the circle?"

"Why," said Paul, "I would be turning the whole barn of course, floor, roof, and all, so—so I guess the pail would swing *crossways* of the barn after I had turned it."

"That's right," smiled Uncle Henry. "We're getting on famously. The pail would be swinging *across* the cracks between the floor boards after you had turned the whole barn a quarter of the way round. Do you all see that?"

The children thought a minute and succeeded in imagining that it would be so. These two pictures show how the pendulum would keep on swinging in the same direction all the time, and you can see that after Paul, the Giant, had turned the barn, the pendulum would be going *across* the cracks of the floor instead of parallel to them.





"Do you think," asked Uncle Henry, smiling, "that you could imagine something else now—something that is a little harder?"

"We'll try anything once," said Peter, speaking for the crowd, and the others said, "Sure!"

The children and Uncle Henry had not been paying any attention to Puck, but now he suddenly interrupted.

"Think! Old One!" he cried from a dark corner of the barn behind the feed box. "Think hard of the picture you would make Petrus and Paulus and the little lady to see—and then look upon the web."

Then the children saw that Puck was standing upon the feed box, pointing to a great circular spider's web filling the entire corner of the walls behind him.

Uncle Henry must have started to think hard at once, for suddenly a picture began to appear on the screen of cobwebs in the corner behind Puck, just exactly as if it was being thrown there by a moving-picture machine.

First the top of a great globe appeared, turning slowly around. It was covered with ice and snow, so the children knew at once that it must be a picture of the arctic regions at the north pole of the world.

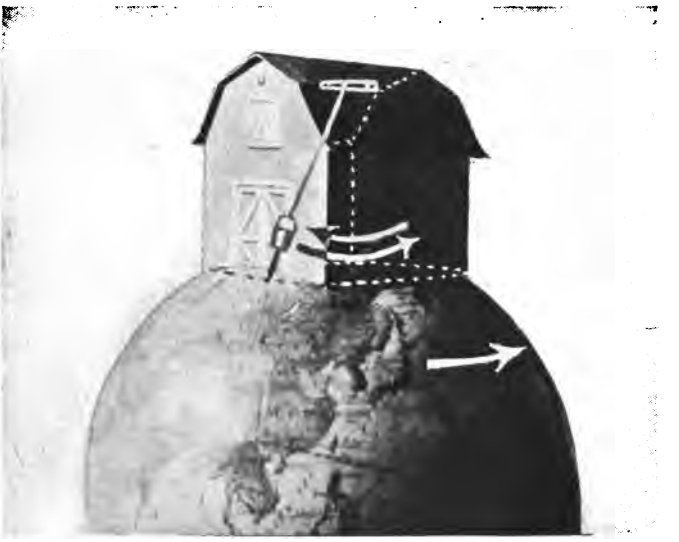
Then the children were startled to see Grandpa's barn appear in the picture. It appeared to be standing on the ice exactly over the end of the axis the great globe was slowly turning around upon.

The picture on the cobweb screen now looked like this:

After the globe had turned once completely around with the barn turning with it, the walls of

the barn in the moving picture became transparent, like glass, and through them the children and Uncle Henry saw the heavy pail of earth swinging back and forth from the beam in the roof.

First it was swinging lengthways of the barn like this:



Then, as the great globe turned the barn round just opposite to the way the clock hands turn, while the pail kept on swinging in the same direction all the time, the children soon saw that the swings were from *side* to *side* of the barn floor, instead of from *end* to *end* of it, like this:

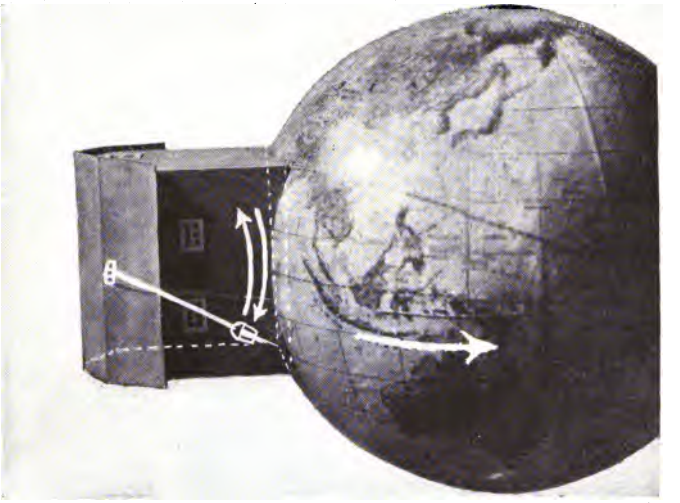
After the globe had turned another quarter of the way round, the pail again swung lengthways of the barn floor, but the front of the barn, with its big doors, now faced away from the children and Uncle Henry, like this:

Another quarter turn of the globe showed the pail once more swinging crossways of the barn floor:

And finally, after the globe had made one complete revolution, turning the barn entirely around with it, the pendulum was again swinging lengthways of the barn floor, with the barn doors facing the children, just as the moving picture was when it started, like this:

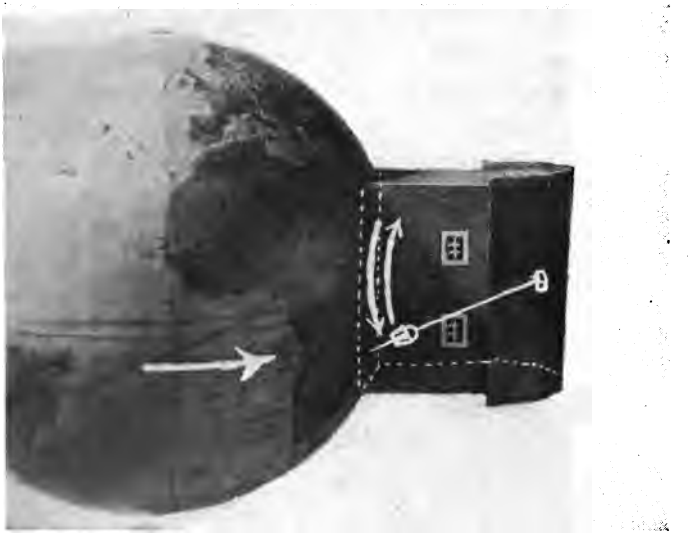
"Thou art a good thinker, Old One!" cried Puck to Uncle Henry as the picture on the spider web faded slowly out. "Now think hard once more—until a new picture moves upon the spider's silvery web—the picture thou and I know of!"

Almost at once the new picture Uncle Henry had in his mind began to be visible on the spider's web, and, as before, Grandfather's barn appeared upon a great, slowly-turning globe—but this time the barn was seen, not at the ice-bound pole, but at the hot, tropical equator, like this:



The heavy pail of earth was swinging in a North and South direction, just at right angles to the equator of the globe; and as the globe slowly turned

the children watched to see the pendulum swing crossways of the barn floor, as it had before, but nothing of the sort happened. Even when the globe had turned half way round, the pail was still swinging North and South, lengthways of the barn floor, like this:



"Oh, I see!" cried Peter, "the pendulum doesn't swing crossways, and stays swinging lengthways, because at the equator the barn doesn't turn around in space. It's different when the barn is at the pole."

"Right," said Uncle Henry. "Now we, here in this real barn, are located somewhere between the equator and the pole of the real earth—about halfway between. It happens that father built this

barn so that the long way of the floor is almost exactly North and South. You can tell that by looking at the weather vane on the cupola. If we should set the heavy pail of earth swinging exactly North and South, what would happen to it while the world revolves from West to East?"

"Oh," exclaimed Betty suddenly, "now I see what the apple twig sticking down from the bottom of the pail is for!"

"Do you?" said Uncle Henry smilingly. "What *is* it for, Betty?"

"Why, I'm sure I *see* it, in my mind you know, but I don't know whether I can *tell* it or not."

"Try anyway," Uncle Henry encouraged her.

"Well," began Betty, "if we start the pail swinging, it's going to keep on in the same direction of course, just the way it did in the picture when we saw the barn at the north pole.

"But while the pail *really* and *truly* keeps on swinging in the same direction it started in, it will really and truly change the direction of its swinging on the barn floor too—and—and—well I guess I can't go any farther after all," Betty finished in disappointment.

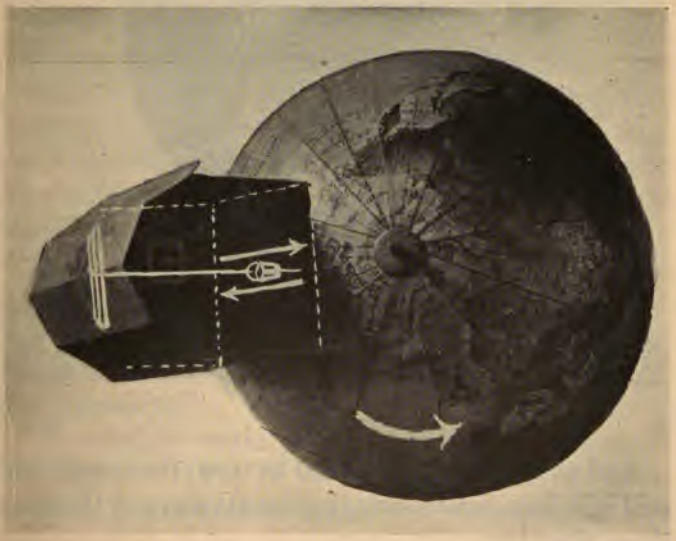
"*Think* the picture, little lady!" Puck suddenly piped up from the feed box, where he had all this time been practicing at walking on his hands.

"Think of what you want to make them see, and all can then see it on the spider's movie screen."

Betty began at once to think of the picture she had had clearly in her mind, but hadn't been able to find

the right words to draw, and presto—right away the globe appeared again on the spider web!

It was turning slowly round on its axis as before, but the children and Uncle Henry seemed to be looking down on the globe from above its north pole. After the globe had turned completely round once, Grandpa's barn appeared upon it, about halfway between the icy pole and the hot tropical equator—just where Uncle Henry had said it was in reality. The barn was placed with the long way of the floor North and South too. Then, as before, the sides became like glass and the children could see the pendulum-pail swinging North and South, back and forth, North and South, like this:



But, as the globe turned, the leafy twig below the bottom of the pail stopped gliding back and forth exactly along the cracks in the floor boards of the barn floor.

As the pail continued to swing, the twig began to brush diagonally *across* the cracks in the floor—and then, when the globe had turned a part of the way round, the pail was swinging crossways of the barn, like this:

And as the globe continued to turn, the pendulum-pail was soon again swinging lengthways of the barn floor, like this:

When the children had watched the globe go through another part of its turn they saw that the pail was again swinging *crossways* of the floor and when the barn had been carried still farther around, the pendulum was returning to the same North and South direction in which it started.

"Do you mean to tell me," cried Peter in sudden astonishment, "that if we start our old pail of dirt here to swinging North and South, or lengthways of this barn floor, that in a few hours it would be wagging crossways?"

"It certainly would," said Uncle Henry, "the only difficulty in the way of our trying it is that the pail wouldn't keep on swinging that long. It *would* swing

for half an hour or so, but our pail of dirt with its twig is so clumsy that I'm afraid we wouldn't be very successful in seeing the small amount that the barn would turn in that time. If we had a better pendulum, with an accurate metal pointer in the bottom instead of our leafy twig, and if it was hung in a room quite free from drafts of air, we could really try it and could measure the amount the world turns in half an hour."

"Who found out all about this? Did you, Uncle Henry?" asked Betty.

"I wish I had," said Uncle Henry, "for I would now be as famous as Monsieur Foucault, who did it the first time with a heavy pendulum hung from the roof of the Pantheon in Paris. That was over seventy years ago, and since then "Foucault's experiment" has been repeated numberless times in all parts of the world. The closer the place where it is tried is to the equator, the smaller the amount the pendulum turns in half an hour. The nearer to the pole the experiment is tried the faster the swinging weight turns away from the North and South line where it is started. At the North Pole, as we have seen, the pendulum turns completely around in twenty-four hours, but the farther away from the pole it is hung, the more slowly it turns until, at the equator, the pendulum never leaves the North and South line at all. It always works just the same, wherever it is tried, and it is the actual proof that the earth turns on its axis from West to East once every day."

"Tell me, Mr. Puck," said Betty to the little green

man, who still sat cross-legged on the dirt in the pail, "did Monsieur Foucault discover his experiment in a Fairy Ring in France?"

"Yes," said Puck, "and I told him there just how far the pendulum would turn on the circle on the Pantheon floor in an hour—before he even tried the experiment at all."

The children looked at Puck quite open-mouthed with wonder. He rose, leaped upward, grasped the wire, and quickly went up it hand over hand to the beam overhead. Then in a moment the pail of dirt fell to the barn floor with a thud and the wire came rattling down after it.

Puck had vanished and Uncle Henry and the children decided to adjourn and go fishing in the creek for the rest of the day. "Foucault's experiment" is wonderful enough to think about for a whole day. See if you don't think so.

FIFTH REEL

IN WHICH UNCLE HENRY MAKES A FUNNY KIND OF SUN-DIAL—THE CHILDREN LEARN TO TELL TIME BY THE BIG DIPPER—AND PAUL'S CAMERA PROVES AGAIN THAT THE WORLD TURNS ROUND EVERY DAY

THE next morning Betty was out in Grandmother's old-fashioned garden picking some "bleeding heart" and pretty blue "bachelor's buttons" for the vases in the house, and while she was there Peter and Paul raced in from the barn with "Rags" in tow. They stopped to look at the sundial that stood on the cement post that Uncle Henry had built for the dial, after he brought it a year or two before as a present to Grandma. It was a beautiful, old, brass sundial that Uncle Henry had found in an antique shop in New York. Around the figures in the circle were these words in quaint old letters:

"L'Amor che muove il Sol e l'altre Stelle"

Peter and Paul leaned their elbows on the edges of the dial and saw that the shadow said "nine o'clock." Then they pronounced the words as well as they could and wondered what they meant.

Talking about the pendulum in the barn the day

before had made them more curious about telling time, you see.

Peter glanced over toward the porch of the house and could see Uncle Henry reading a book in the hammock.

"Uncle Hen!" he called.

Uncle Henry sat up and looked out into the sunlit garden. It must have looked inviting to him, with the three children and their dog around the sundial among the sunflowers and marigolds and verbenas, for he closed his book right away and came over to them.

"What is it, Pete?" he asked.

"What do these words mean?" Peter inquired.

"Yes, and what makes the sundial tell what time it is?" asked Betty, who now had picked all the flowers Grandma needed and taken them into the house.

"And please tell me," said Paul, "how I can take a real good picture of the moon with my Kodak. I tried it 'fore you came last month and there wasn't anything but a white streak in the picture when it was printed—and it ought to have been better, 'cause I exposed the picture for ten minutes."

Uncle Henry laughed.

"I'll begin with the first question first," he said, "because it is the easiest one to answer.

"The words on the sundial are Italian and they mean,

'The Love that moves the sun and the other stars.'"

The children were quiet a moment before Betty said,

"I like that. It's beautiful—like poetry—and some of Mamma's songs—like, 'The night has a thousand eyes.'"

"But *is* the sun a star?" inquired Paul.

"Yes," Uncle Henry assured him, "it is just the same kind of a star as those you see at night, except that we are much nearer to the sun, so it looks very much brighter. Some of the far-away stars are much bigger suns than ours."

"Well," said Paul, "it's a good thing we *are* near to the sun, 'cause if we weren't, this sundial wouldn't work at all, and I like to watch the shadow creep. You can almost see it move. Why *does* it tell time, Uncle Hen?"

"Well," said Uncle Henry, "I move that we go out into the Fairy Ring and wonder about it. Perhaps if we think hard enough Puck will come and help us to find out all about telling time."

"That'll be great," said Peter.

"It might be a good plan to take your Scout's compass, a wooden barrel or cheese-box hoop, about a yard of lath, a hammer and some little nails, and plenty of strong string along," suggested Uncle Henry. "They might help us to think better. Oh, yes, and we'll have to borrow Rags' white rubber ball from him too."

Peter went to hunt lath, nails, hammer, and string; Paul went to find an old barrel hoop; and Betty started in search of Rags' ball. They were

all to meet in the Stump Meadow by the Fairy Ring in fifteen minutes.

When Uncle Henry found the children there he had also one of his big pads of drawing paper with him, and a mysterious little, flat black box.

Uncle Henry sat on Puck's stump and the children sat around him on the grass inside the mushroom ring.

"Pete," said Uncle Henry, "have you got your jackknife with you?"

"Sure!" said Peter.

"All right. Cut this wooden hoop into two half circles," commanded his Uncle.

When the hoop was cut, Uncle Henry showed Peter how to cross the two half hoops at right angles and tie them with heavy cord at the middle. Then he tied the cut ends of one of the half hoops together with a heavy cord, as if it was a bow, and the two hoops looked like this:

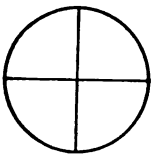
"You remember," said Uncle Henry, "that the globe you have in the playroom at home turns round on its axis, just as the earth does?"

The children remembered very well indeed.

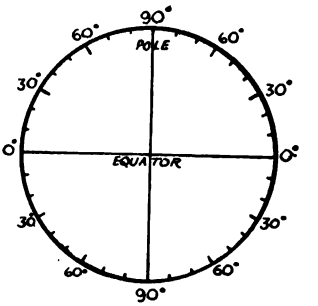
Uncle Henry then opened the fascinating little black box he had brought. It proved to contain a set of drawing instruments—compasses and everything.

In a moment the compasses had made a circle on the drawing pad and Uncle Henry had drawn a verticle line through the centre of the circle.

Then he drew another line through its center. This was at right angles to the first line, and the two divided the circle into quarters, like this:



Uncle Henry then divided each quarter into thirds and each third into smaller thirds. After the figure 90 was written at each end of one of the lines and 0 at each end of the other, the circle looked like this:

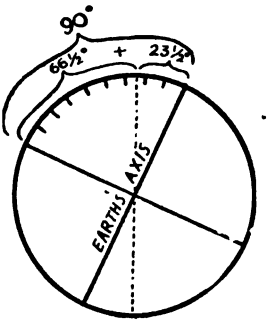


"Every circle," said Uncle Henry, "is divided into four quarters, and each quarter into ninety small, equal parts or 'degrees.' Four times ninety is three hundred and sixty degrees for each complete circle.

"Now if the earth stood up and spun around the sun with its axis parallel to the sun's axis (for the sun revolves like a top too) it would be like this:

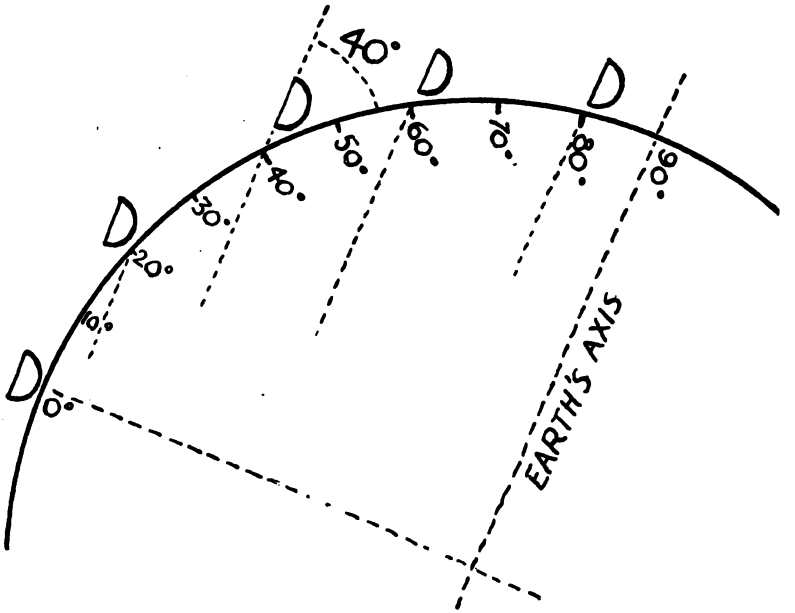
"But instead of doing that the earth's axis slants twenty-three and one half degrees away from the vertical, like this:"

This shows how much twenty-three and one half degrees is.



"This slant of the earth's axis away from the line of the sun's is the cause of our having warm Summers and cold Winters. We'll find out about that some other time. Just now we want to find out what makes the sun-dial tell time."

Uncle Henry then drew the quarter circle that lies between the equator and the pole of the earth larger, and at intervals of twenty degrees along the curve his compasses drew small half circles with straight lines joining the ends of the bows. These short lines were all parallel with the long line representing the axis of the earth. This was how the drawing looked:

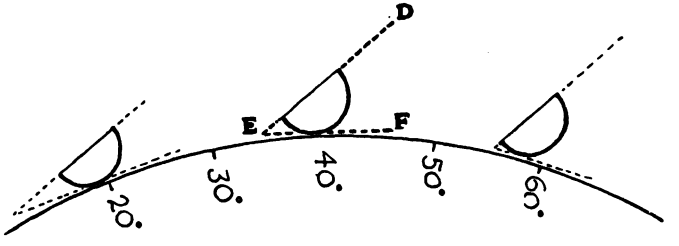


"We found out yesterday," continued Uncle Henry, "that here on your Grandpa's farm we are about half the distance between the earth's equator and pole. To be exact we are just four-ninths of the way, or just forty of the ninety degrees away from the equator. Astronomers would say that our farm is at 'forty degrees north latitude.' Now, Paul, show us how we ought to place our barrel-hoop sundial on Mr. Puck's stump here, so that the stretched bow cord will be parallel with the earth's axis."

Uncle Henry got up from the stump and handed the barrel hoops, tied together, to the little boy.

Paul looked carefully at the drawing of the little circular bow at the point in the big quarter circle where the figure 40 was placed, and put the barrel hoop on the stump so that the stretched cord made the same angle with the ground as the line representing the cord did with the curve of the earth in the picture.

These next two pictures show how the angle ABC is the same as the angle DEF:

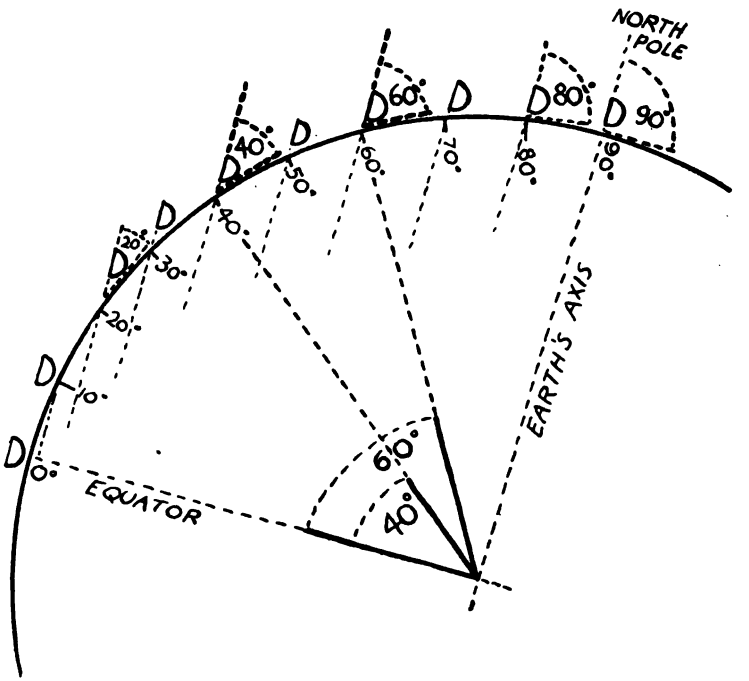


"If we lived at sixty degrees north latitude instead of here," said Paul, "the line of the cord would tip up more, wouldn't it?"

"Yes, and that reminds me of something else," said Uncle Henry. "I can show you with the compasses more quickly than I can explain it."

The little compasses started to work once more and Uncle Henry showed, with the aid of parts of dotted circles added to the large picture of the quarter circle, that the number of degrees in the

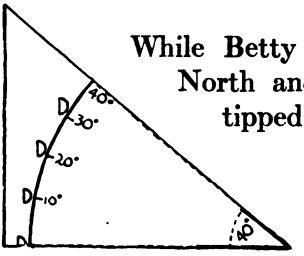
angle the cord made with the ground was always the same as the number of degrees of latitude of the place. This shows it better than words:



When the children all understood that the cord of the bow in the barrel-hoop sundial must always be parallel to the axis of the earth, Uncle Henry said,

"Now we must do just one more thing before our sundial will be ready to tell time. Paul, bring the Scout's compass and lay it on the stump so we can see where the North is."

Paul did, and Uncle Henry turned the bow of the hoop until the cord stretched upon it pointed in the same direction the magnetic needle did. Then, while Betty held the hoop motionless, Uncle Henry cut away the big quarter circle he had drawn on the paper until only a V-shaped piece was left. The angle at the point of it was an angle of just forty degrees, like this:



While Betty held the barrel hoop in a North and South position, Paul now tipped it until the V-shaped piece of paper just fitted into the angle between the cord and the stump, like this:

Then Peter nailed the barrel hoop firmly to the

stump and the dial was properly adjusted to tell time at the point on the earth's surface where Grandpa's farm is located—forty degrees north latitude.

"If we come out here to-night," said Uncle Henry, "and sight along the cord, from the bottom end toward the top end of it, we shall find that we are looking straight at the north star, which is called *Polaris* because the polar axis of the earth points at it.

"You see that *Polaris* is so far away that the thickness of the earth is nothing in comparison to the immense distance, so any line parallel to the earth's axis will also point to *Polaris*."

By the time the children and Uncle Henry had their barrel-hoop sundial finished and adjusted Uncle Henry's watch said that it was noon.

The shadow of the cord then fell across the middle of the "crossways hoop" and along the inside of the "bow hoop," like this:

"Ooh!" cried Betty, "*now* I see what the crossways hoop is for!"

"What *is* it for?" asked Uncle Henry, smiling with pleasure, as he always did when the children discovered things for themselves.

"Why, it's to catch the shadow in the morning and afternoon. The arm of the hoop toward the West catches the shadow of the cord in the morning, and the one toward the East catches it until sunset."

"Quite right" agreed Uncle Henry, "and since you've discovered it, Betty, we'll let you take this piece of chalk and mark the hours on the inside curve of the 'crossways hoop.'"

Uncle Henry had produced a piece of white chalk from one of his always surprising pockets, and showed Betty how to divide off each arm of the "crossway hoop" into six equal parts or hours.

This is the way the sundial looked a little later in the afternoon when the shadow of the cord crossed the East arm of the "crossways hoop" at about the three o'clock mark.

"Why," asked Paul, "is the sundial in Grandma's garden flat, while the one of ours is round?"

"This one would be just the same as your Grandma's," said Uncle Henry, "if we cut off the arms and then took that triangle of paper we used to find the right slant of the cord, and fastened it upright under the cord,"

This picture shows these things, and also that the figures for the hours would have to be put in the flat top of the stump instead of on the arms of the hoop.

By this time the children knew that it was dinner time without any assistance whatever from sundials of any kind, so the meeting adjourned, leaving the sundial on the stump to count the hours until the children should come back to it again.

Steadily and smoothly the earth turned from West to East, and just as steadily the shadow of the cord traveled along the inside curve of the Eastern arm of the dial, until the sun seemed to sink in the West and Luna Moon, now almost half full, appeared in the sky.

During the afternoon Uncle Henry showed the children this picture of the largest sundial in the world. It was built in India by a powerful Rajah nearly two hundred years ago. The half circle where the shadow falls is one hundred feet in diameter and the slanting wall that casts the shadow is ninety feet high. The shadow moves in the curved surface at the rate of two and one half inches every minute.

From Astronomy; A Popular Handbook, by Harold Jacoby, The Macmillan Company.

It was quite dark when a little procession, headed by a young man with a barn lantern, left the farmhouse and started for the Fairy Ring in the Stump Meadow. Paul carried a school slate and had chalk in his pocket.

"Our sundial will be asleep now," said Betty.

"Yes," said Peter, "but it'll wake up the moment the sun comes up."

"How would we be able to tell time at night, Uncle Hen," asked Paul, "if we didn't have any clocks or watches?"

"Just the same way people told it at night before there were any clocks or watches," said Uncle Henry.

"But how was that?" persisted Paul.

"By the big clock in the northern sky," said Uncle Henry.

The children tried to see his face to find out if he was joking, and when they saw that he wasn't they looked up at the northern stars with puzzled expressions.

By this time they had all arrived at the Fairy Ring and Betty cried,

"Oh, I want to find *Polaris*, the north star, the way Uncle Henry said we could this morning."

So the little girl lay down on the sod and looked upward and Northward along the line of the sundial's cord.

"It really does do it!" she cried.

"Does do what?" said Peter.

"The cord really does point out the north star,"

cried Betty. "I know it's the north star because the pointer stars in the big dipper show that it is."

"Yes, that's right," said Uncle Henry, "and the north star is the place where the hands of the star clock are fastened on. It is the centre of the dial, that never moves, the point that all the other stars in the northern sky swing around in circles, once every twenty-four hours."

"How do people know that?" asked Peter.

"Well, one good way to know is to take a photograph of them doing it," said Uncle Henry. "Paul wanted to take another picture of the moon because the last time he tried it he got only a black streak on the plate. That was a *good* picture instead of a bad one, for it told the story of the earth's turning on its axis. So now, instead of another picture of the moon, I propose that we point the Kodak at the north star and let it be telling its true story silently on the sensitive plate for an hour or so, while we talk about the great star clock up there, and learn to tell time the way the shepherds with their flocks did, centuries ago, before watches were ever even dreamt of."

"Ooh, that'll be great!" exclaimed Betty. "Let's start the Kodak to work right away, and when we get back to the house Peter can develop the plate and see what the north star's story is."

Uncle Henry focused the Kodak for a "distant view" and propped it up on the stump so that it pointed upward, parallel to the line of the cord on the sundial, like this:

Then he carefully opened the shutter for a time exposure and let the camera stand where it was.

"Now we can forget the Kodak," he said, "it will keep right on doing its work, and will tell us all about it later on. Everybody find the big dipper now, and we'll soon be able to tell time by the stars at night, just the way we do with our sundial in the daytime."

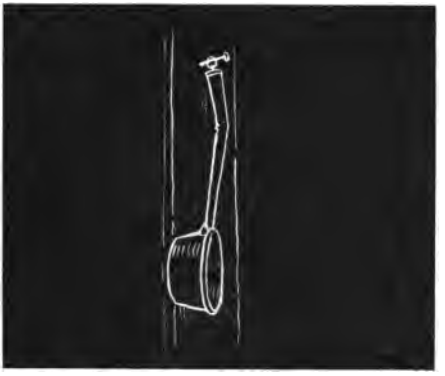
The children had all found the big dipper now and Betty said,

"It's hanging down by the end of its handle, just as if it was on a nail."

"Yes," said Uncle Henry, "the dipper is like that in the evening in Summer, and since it is now just about July first and about nine o'clock in the evening, the dipper is hanging down very straight

from the end of its handle, with its bowl just at the left of the pole star."

This shows how the children saw the big dipper, or great bear.



Then Uncle Henry explained that the dipper was just on the opposite side of the pole star in the Winter, on January 1st at nine P. M., but standing on its handle like this:

It's just as if some juggler was balancing the handle on his hand or on the end of his nose!" cried Paul.

"Precisely," agreed Uncle Henry.

"Now we'll see," he went on, "how the dipper looked in Spring, say on April first, at the same time in the evening."

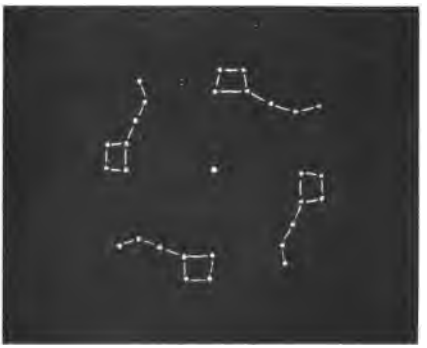
Here Uncle Henry took the slate from Paul, and drew, by the light of the lantern, both the Summer and Winter positions of the dipper, and after them the Spring and Autumn ones. In Spring it was upside down with the water all spilled out, like this:

But in Autumn the dipper was standing solidly on the bottom with all the water safely held in it, like this:

"Oh," cried Betty, "I begin to see where the hands of the star clock are, but they tell *months* instead of hours."

"That's fine!" said Uncle Henry enthusiastically. "show us with this pencil," and he handed the chalk and slate to the little girl.

Betty then drew the dipper in each of its four positions, but she put all of them in one picture, like this:



"That's the clock's face," said Betty, "but I don't know where to put the hour figures and the hands."

"This clock has no minute hand," said Uncle Henry, "just an hour hand. As for the figures, we'll find out about them right away."

Then Uncle Henry put the figure 9 just beside the dipper in its Summer position, and drew in a clock hand pointing to it.

"Now," said Uncle Henry, "our star clock is right; it says 'nine o'clock, July 1st.' Who can tell me where the hand will point at midnight to-night? Remember that our clock turns from right to left, just opposite to the way our ordinary clock or watch does."

"Why is that, Uncle Hen?" asked Peter.

"You know if you stop and think a moment," said Uncle Henry.

The children thought a minute or so and then Paul said, "I know."

"Well then," said Uncle Henry, "tell us why."

"I'll try," said Paul. "The right of the north pole star is East and the left if it is West, so if the clock hand turns from right to left it turns from East to West. But it only *seems* to turn because the earth is always turning from West to East, just the opposite way."

"Very good, indeed," praised Uncle Henry, "now perhaps you can go on and tell us where the clock hand will point at midnight to-night. Draw it on the slate when you have made up your mind."

Paul promptly drew the hand pointing straight downward, like this:

"Your mistake is very natural," said Uncle Henry. "Three hours on a watch dial *is* a quarter way round, but remember that the hands on a watch must travel *twice* round the dial every twenty-four hours. Remember too, that our star clock hand turns only *once* round in twenty-four hours. Then try again."

Paul thought this over and then drew the position of the hand at midnight only half as far advanced beyond its nine o'clock position.

"I see," cried Peter, "it goes a quarter way round every six hours, and four times six are twenty-four!"

"Quite true,' smiled Uncle Henry, "so now you know how to tell time by the great star clock."

The children had not thought it was quite as simple as that, so they weren't sure whether they knew how or not.

"Try us some way and see if we know," said Paul.

"All right," Uncle Henry agreed, "you already know the nine and twelve o'clock positions for this month, July. Now I'll draw the hand in another position and you see if you can tell the time of night it would be if you saw the dipper in the same position up there in the sky."

"That'll be fine!" cried Betty, "it's a new game to play!"

So Uncle Henry drew the dipper and imaginary clock hand in this position.

"What time of night would it be if the dipper was like that, right under the pole?" asked Uncle Henry.

After a little thought the children all agreed that it would be three o'clock in the morning, since the hand had moved a quarter of the way around the dial, and a quarter of twenty-four was six, and six hours after nine P. M. was three A. M.

Then Betty said, "But, Uncle Henry, "the hand

of the clock points the same way at three o'clock in July as it will at nine o'clock next October."

Uncle Henry was pleased.

"That's fine, Betty," he said. "You've discovered that the dipper is not only a clock, but a calendar as well. People in old times used the other stars and the dipper as their only calendar.

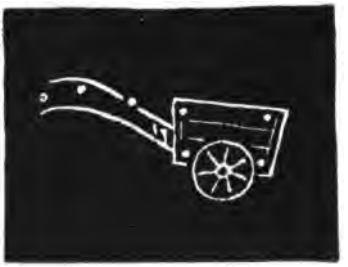
"Before clocks and watches made them forget how to do it, everybody knew how to tell time by the stars, too. Even as recently as Shakespeare's time lots of people did. In his play "King Henry the Fourth," one of the wagoners in the Rochester inn-yard scene says,

'Heigh-ho! an' it be not four by the day, I'll be hanged; Charles' Wain is over the new chimney, and yet our horse is not packed!'"

"What is Charles' Wain, Uncle Hen?" asked Paul.

"It's the same as the big dipper with us," explained Uncle Henry. "In England they call it Charles' Wain. This will show you why."

Then Uncle Henry drew this little sketch to show how the dipper obligingly becomes Charles' Wain, or wagon, when English people look at it.



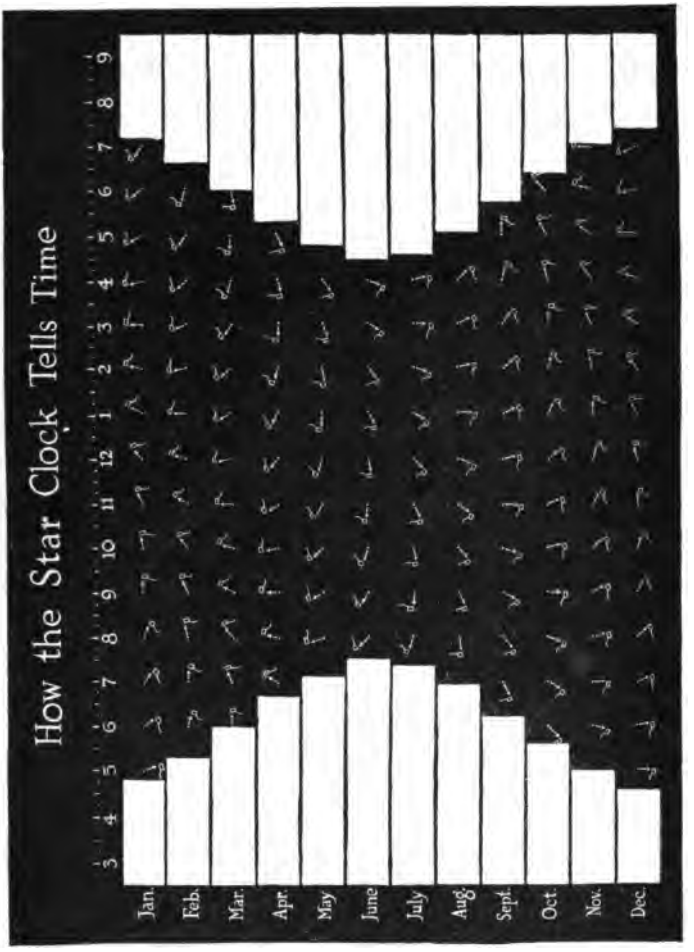
"Well," said Paul, "I'm going to get so I can tell time by the dipper clock any time of night and any time of year."

"Me, too!" echoed Peter and Betty.

"It's very easy," said Uncle Henry. "The position of the clock hand at nine o'clock in February is just one-twelfth of the way farther round than its January position, going the opposite way a watch hand does. In March the nine o'clock position is another twelfth of the way round and so on through the year. Then, as soon as you know the hand's nine o'clock position for any month, it is easy to see that at two, three, four, five, or six hours later the hand will have moved two, three, four, five, or six twenty-fourths of the way round from right to left."

The "moving picture" of the great star clock's hand and the dipper on the next page shows their position for every month in the year and for every hour of the night. You will see that in the long winter nights of December the clock hand is visible almost three-quarters of the way round, while in the short summer nights of June it can be seen through less than half a complete revolution.

When Uncle Henry and the children had looked at the star clock and talked about it as long as they wanted to, they closed the shutter of the camera and all trudged back to Grandfather's farmhouse, but Peter and Paul insisted on sitting up while Uncle Henry developed the plate that told the stars' story of the earth's rotation around its axis.

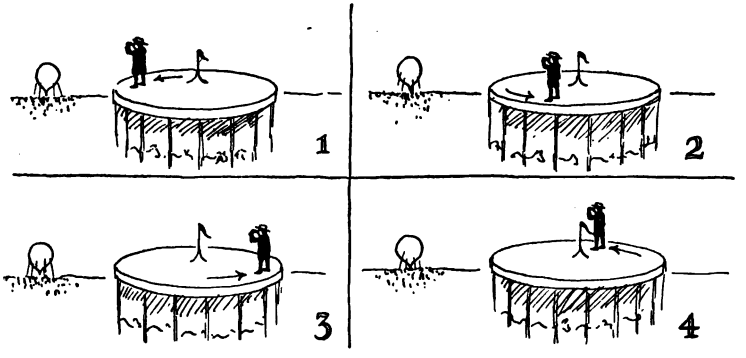

How the Star Clock Tells Time
3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

Next morning they made a print from the negative and it looked like this:

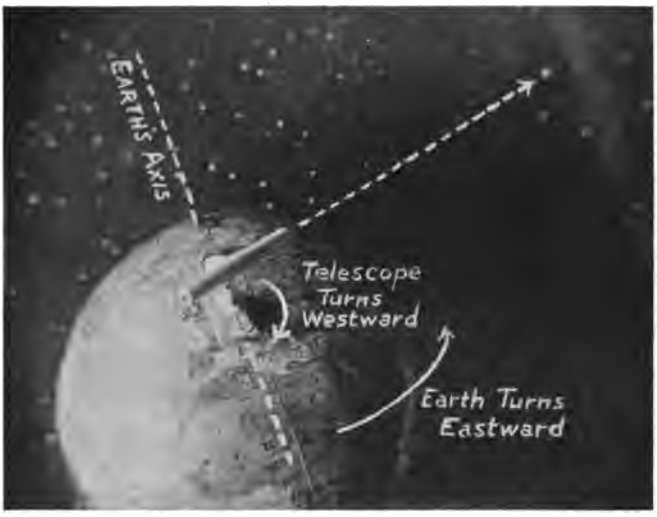
You see the stars of the dipper made long circular trails, while the pole star remained almost still at the centre of all the curves. Since the picture was exposed for only an hour the curves were only one-twenty-fourth of complete circles, as the earth had turned for only one of the twenty-four hours while the picture was being exposed.

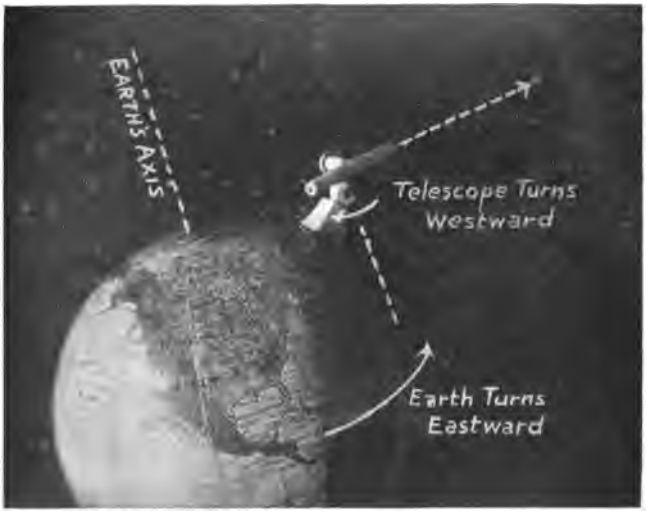
These four little pictures show that if a boy stood on the roof of a merry-go-round while it was running, and wanted to keep an opera glass pointed at the balloon ascension too, he would have to keep

turning himself every moment to avoid turning his back on the balloon. The boy turns around on his own axis, which is parallel to the axis of the merry-go-round.



Now imagine that the revolving world is the merry-go-round and that the big telescope, turning on an axis that is parallel to the axis of the earth, is the boy with the opera glass. Then, when you have looked at these next two pictures a moment, you will see how an astronomer is able to keep a big telescope continually pointing at the same star as long as he wants to look at it. The earth keeps turning from West to East and the telescope keeps turning the opposite way, from East to West —so it keeps on pointing at the star, just the way the opera glass of the boy riding on the roof of the merry-go-round kept on pointing at the balloon.


EARTH'S AXIS
Telescope Turns Westward
Earth Turns Eastward


EARTH'S AXIS
Telescope Turns Westward
Earth Turns Eastward

The next picture is a photograph of the Yerkes telescope, the largest of its kind in the world. It keeps pointing at any star that the astronomer wants to look at, because it turns round on a slanting axis that is exactly parallel to the polar axis of the world.

The camera that Uncle Henry propped up on the stump to take the picture you have just seen—the stars around the pole—was a Kodak with a "rapid rectilinear" lens. If you want to take a similar one, be sure to open the "iris-diaphragm" of the lens as wide as it will go. You will not get a good picture unless the stars are very clear and bright—and the moon must be out of the sky. When it is moonlight the camera can not see the stars any better than you can.

If you happen to have a camera with an "anastigmat" lens (F 7.5, F 6.3, or larger) you will get a still better picture than the "rectilinear" lens will make, because the "anastigmat" lens will let in more light from the stars.

If you have no camera, you can make one that will take quite good star pictures. Take an ordinary reading glass, cut a round hole, about an inch in diameter, in the end of a cigar box, and fasten the reading glass over the opening. Then open the lid of the cigar box, hold a white card inside and watch the picture that the reading glass throws on the card when you point the lens at a distant tree or building.

Mark the place where the picture is clearest. Put a card-board partition in the box at this place. Then, when night comes, go into a dark room and lay a glass photographic plate on the partition, with the film side toward the lens. Close the box carefully and cover up the reading glass with your cap or any other handy piece of dark cloth.

Now you are ready to take the picture. Go out doors and prop up your box camera so that it points toward the pole star. Then uncover the lens and leave it for an hour. Cover the lens with the cap again and take the camera, with the plate inside, to be developed.

SIXTH REEL

THE CHILDREN GET ACQUAINTED WITH OLD SOL'S FAMILY—AND FIND VENUS, MARS, AND THE EARTH GROWING IN A PEA POD

THE next morning at breakfast Grandmother told Peter and Paul that they might go out to the garden, pick a nice watermelon, and put it down in the cool cellar until dinner time.

"Your Uncle Hen," she said, "will go along and tell you which are the ripe ones."

So the children all trooped out, with Uncle Henry bringing up the rear, and for a few minutes they were all thumping the melons to find the ripest one.

"They're not quite as round as the geography globe, are they," said Betty, "but the stripes coming together at the stem ends make me think of it."

"They *are* rather like the meridians coming together at the pole of the globe, aren't they?" Uncle Henry agreed.

He thought a moment, looked off across the field beyond the garden, and then said,

"I'll tell you what we'll do, youngsters, if you feel like it. After Pete and Paul have taken this melon we've selected down into the cellar we'll start with that other big melon over there—the really round one with the stem right on top—and play a game called 'Old Sol's Family.'"

"Ooh, great!" cried Betty. "We're in Old Sol's family too, aren't we?"

"Yes, and I wonder if you can tell who all the brothers and sisters of our world are," said Uncle Henry.

"Well," said Paul, "I know *Mars* is one of them."

"*Saturn* too!" added Peter, "with his rings. I've seen 'em in pictures lots of times."

"All right," laughed Uncle Henry, "run along down in your Grandmother's cellar with the melon for dinner and Betty and I will guard our 'Old Sol' here on the ground until you get back."

When the boys returned Paul said,

"You mean the big round melon is going to stand for the sun in our game?"

"Exactly," said Uncle Henry. "This melon is about a foot and a half thick and nearly round, so he'll do for Old Sol very nicely."

Then Uncle Henry took a bit of stick and began scooping out the soft dirt beside the big watermelon. He kept on until he had a round, cup-shaped hole big enough to hold the melon up to its middle. Then he placed the big melon in the hole and leveled the dirt smoothly all the way round, like this:

"What's that for, Uncle Hen?" asked Paul.

"Well," said his Uncle, "all of Old Sol's family revolve around him in circles at the same level or 'plane,' and this plane goes through the equator of the sun—just the way the level of the ground here in the garden goes through the center of our half-buried melon. So we'll let the top of the level ground represent the 'plane of the ecliptic,' as astronomers call it."

"What does 'ecliptic' mean?" inquired Betty.

"It comes from the word 'eclipse,'" said Uncle Henry, "and sometime we will see how eclipses, either of the sun or moon, must always occur in the 'plane of the ecliptic.'"

"Well," said Peter, "we started out to find Old Sol's family; where is the first member?"

"Over there in a green pod hanging on the pea vines; you can pick it and bring it over here if you like," said Uncle Henry.

"In a pea pod?" cried Betty in astonishment.

"Certainly," said Uncle Henry, "*Mercury* is the littlest brother in Old Sol's family of planets, and compared to his father, the sun, represented by our big watermelon here, *Mercury* is the size of a very small pea indeed. Let's open the pod Peter has there and see if we can find one small enough. Our *Mercury* should really be a little smaller than a double B shot, such as you use in your air-rifle."

"Oh, I've got some BB shot in my pocket. Here's one," said Paul.

"That's fine," said Uncle Henry. "Now you

run into the barn, Peter, and get your Grandfather's long tape measure out of his tool chest. We want to know how far to put little brother *Mercury* away from his father, the sun."

When Peter came back with the tapeline, Uncle Henry asked Betty to hold the end on the stem of the big "sun-melon." Then he ran out the tape as he walked away toward the Stump Meadow. He kept on going so far that the children thought there must be some mistake and Peter said so.

"No," said Uncle Henry, laughing, "this 'Old Sol's' family of *ours* is going to be in the right proportions. Some of the pictures of the solar system you see in atlases and geographies give you entirely wrong ideas about the sizes of the planets, and their distances from the sun. The planets are often shown both too large and too close to the sun. Our BB shot, or *Mercury*, needs to be 62 feet from the "sun-melon" in order to show the right proportional distance of the real *Mercury* from the sun."

So Paul put down the BB shot and stuck up a twig in the dirt to mark the place.

"I wonder," said Betty suddenly, with a note of anxiety in her voice, "what has become of Mr. Puck? We didn't see him all day yesterday. I wonder if he got offended about something."

"It's like this," said Uncle Henry, "Puck has to bring so many answers to people in Wonder Rings everywhere that he's terribly busy all the time. So as soon as you get to be able to answer some of your questions yourself he lets you do it. You'll find

that when you really need Mr. Puck's help again he'll appear, just as suddenly as he did the first time. You'll find too that the more questions about everything that you figure out yourself the more you'll be able to."

"Well," said Peter, "Puck or no Puck, let's go on to the next of *Mercury's* brothers. Or maybe it's a sister. Is it?" he asked Uncle Henry.

"Yes, it *is* a sister this time. Only one girl in a family of eight though—unless you want to include our own earth as a lady."

"I think we'd better," said Betty, "because people talk about 'Mother Earth' you know."

"Quite right," said Uncle Henry. "Well, then, let's go ahead and find *Venus*, the daughter of Old Sol who is just beyond *Mercury*, between him and 'Mother Earth.' Peter, give me that pea pod you picked."

"Peter Piper picked a pea pod!" sang Betty.

"Yes," said Uncle Henry, as he snapped the pod open, and picked out two small peas of almost the same size, "and the pea pod Peter Piper picked had *Venus* and the *earth* both in it."

"Are they really as much alike as that?" asked Betty.

"Yes," Uncle Henry assured her, "as far as size goes, *Venus* and the *earth* are as alike as two peas."

"How big is *Mars*?" asked Peter.

"Here is *Mars*," said Uncle Henry, as he selected a pea a little over half the size of the one representing the earth and Venus.

"Come on," said Paul, "let's see how far beyond *Mercury* we have to go before we put down *Venus*."

Uncle Henry ran out the tapeline again while Betty held the end of it at the point where *Mercury*, the BB shot, was placed. After 62 feet of the tapeline was out Uncle Henry stopped and said,

"Bring *Venus* here, Peter. It is 124 feet from the melon where the orbit of our twin sister pea is."

Peter brought *Venus*, set it on the ground, and stuck another twig up beside the pea to mark the spot.

"Forward march again!" cried Uncle Henry, so Betty held the end of the tapeline beside *Venus*, and the tape was run out 62 feet more.

"I know what to do now," said Peter, and put the other pea of the same size as the one used for *Venus* down where Uncle Henry had stopped.

"There is our 'Mother Earth,'" said Uncle Henry, smiling at the pea on the ground. "Better mark it with another piece of stick, Paul, or we may lose sight of it entirely. Our world seems big to us, but it is just a pea in comparison with the big, circular path in which it travels round its father, the sun. It's no wonder we are a whole year in whirling completely round our circular path, is it?"

Then Uncle Henry marked on the ground to show how many times its own thickness the world traveled along its path every hour.

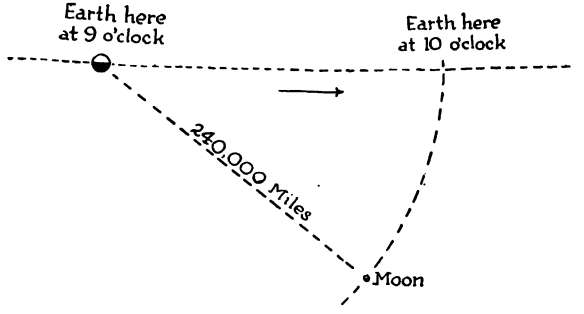
"It is nine o'clock now," he said. "At ten o'clock the earth will be thirty times its own thickness,

which is about 8,000 miles, along its path toward Autumn. How many miles is that?"

Peter was good at figures and said "240,000 miles," right away.

"Yes," said Uncle Henry, "and that happens to be just about the distance of our moon from the earth. Let's find a tiny stone, only about a quarter the diameter of this pea, and place it at the right distance from 'Mother Earth.'"

This shows how the earth and the moon looked when this was done. The mark on the earth's path shows the distance the world travels, with the moon in tow, in one hour.



"Now, let's find *Mars*," cried Peter, "I saw a picture in one of papa's books and it was a map of *Mars*, and it said there were 'canals' on it—like the Panama Canal, I s'pose."

"Nobody knows for sure about the canals yet," said Uncle Henry, "but I'll show you some other interesting things about our little brother planet, after we find out where all the rest of Old Sol's

family are located. They have all been small so far, and *Mars* is even smaller."

Uncle Henry selected a pea from Peter's pod, a little over half the size of the "earth-pea" and it was duly deposited 93 feet farther from the "earth."

"The next member of our family of worlds is different," said Uncle Henry. "*Jupiter* is the next, and he is a lot bigger than *Mercury*, *Venus*, and the *earth* all put together. We're going to need something bigger to represent him. Let's see—how abut a green tomato? I guess that will do. Paul, pick a green tomato about one and three-fourths inches across and bring it along. We're going to make a big jump now, for it is a long, long way from our earth to Jupiter."

It *was* a long way, for while Betty held the end of the tapeline beside the pea-earth, Uncle Henry went farther away, and farther, unrolling the tape as he went. The tapeline ran all out and Betty had to go forward to the end of it and hold the end there while Uncle Henry went a long way farther on. They had gone over 650 feet from the "pea-Mars" before he called to Paul to bring the green tomato and set it down.

By this time the children and Uncle Henry were 930 feet from the melon that stood for the sun. They were away out of Grandfather's garden, out nearly across the ten-acre pasture, on the way to the Stump Meadow.

"My," said Peter, "if the sun looks as small from

Jupiter as the melon back there does from this tomato here, I'd hate to live on *Jupiter*."

"You would get very little sunlight and not much heat, that's sure," Uncle Henry agreed.

"How much farther is the next member of Old Sol's family?" asked Betty.

"Oh, about 830 feet," said Uncle Henry. "I'm glad you mentioned it, for we'll need another small green tomato—a baby one—to represent *Saturn*, the next planet."

Paul ran back into the garden and brought one about an inch and a half across.

"That'll do fine." said Uncle Henry, "let's measure off the distance and put *Saturn* where he belongs. Did you set up a stick beside *Jupiter*, so that we can find him again, Paul?"

Paul had.

Then Uncle Henry and Betty used the tapeline again and found the place for Saturn, away out in the centre of the Stump Meadow, over 1760 feet, or a third of a mile, away from the sun-melon in Grandfather's garden.

The place for Saturn just happened to be right close to the Fairy Ring, so when Saturn was set down on the ground in his right place, the children and Uncle Henry sat down on the grass in the Ring to rest a little.

"How many more children has Old Sol?" asked Peter.

"Two," said Uncle Henry, "and if we want to go on and put them in their proper places, we can repre-

sent them by two marbles, each about half an inch in diameter."

"How far are they from *Saturn?*" asked Paul.

"Well," said Uncle Henry, "the spaces between the planets get wider and wider the farther you go from Old Sol. The next planet, called *Uranus,* would be a whole third of a mile farther beyond *Saturn,* and if we wanted to put *Neptune,* the last planet, in place, we should have to keep going until we were 300 feet more than a mile from the 'sun-melon' back in Grandpa's garden."

"My," cried Betty, "let's just pretend we've done those two."

"Shall we?" asked Uncle Henry of the two boys.

"Sure," they agreed.

"All right," said Uncle Henry, "and in place of doing that I'll tell you what we'll do. We'll play 'Old Sol's movies.' It's a game that will show us how Old Sol's children move in the sky over our heads."

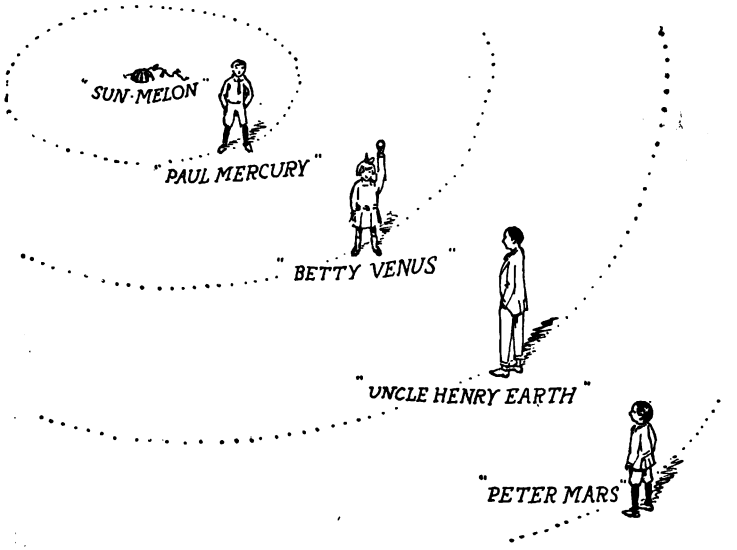
"Fine!" cried all the children, "how do we start?"

"We start by being named," said Uncle Henry. "Peter, you are *Mars;* Paul, you are *Mercury;* Betty shall be *Venus;* and I'll be the earth. Now we'll all go back and find the BB shot that stands for *Mercury,* and the three peas that stand for the others. When we've found them we'll each stand in the spots where they are. Then we shall see what we shall see."

"*Mercury,*" "*Venus,*" and "*Mars*" jumped up

and raced off back toward the garden, while "Uncle Henry Earth" followed as fast as he could.

When he arrived at the place where the twig marked the place of the "pea-earth," the children all had found their stations. If you could have looked down upon the garden from above, the children and Uncle Henry would have looked like this, except that they would have been a good deal farther apart.



The dotted circles show the paths the planets travel around the sun.

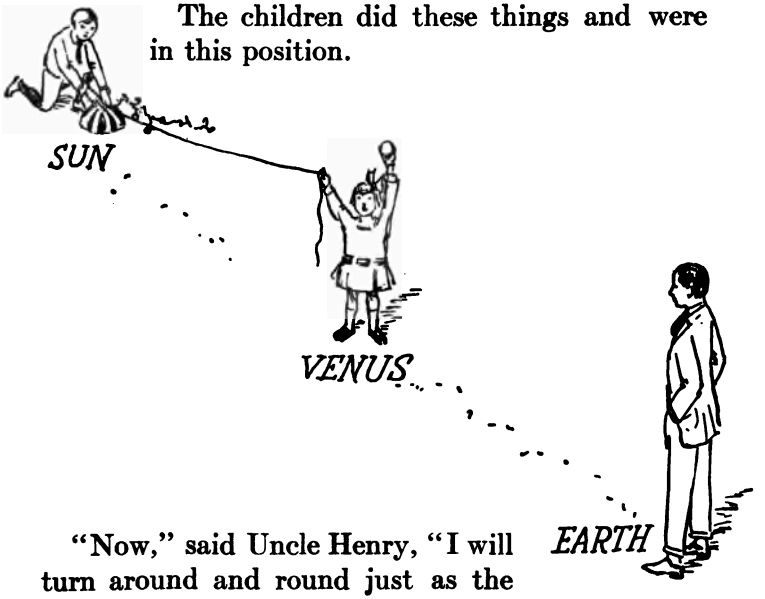
"Betty," called Uncle Henry, "do you know the name of the bright star you saw in the west every evening last spring, just after sunset? It came into

sight almost before the glow was gone from the sky."

"The evening star," Betty called back from her place in *Venus*' position.

"Yes," said Uncle Henry, "it was the 'evening star,' but its right name was *Venus*. Paul, you leave your position as *Mercury* a little while. Give Betty Grandfather's tapeline and the ball you have in your pocket. Now you take the other end of the tape and hold it on the top of the 'sun-melon.' Betty, hold the ball up over your head."

The children did these things and were in this position.



"Now," said Uncle Henry, "I will turn around and round just as the earth does on its axis every day. No matter how I turn, Betty is in line with the sun and with me. If the melon was a bright light like the sun, the light

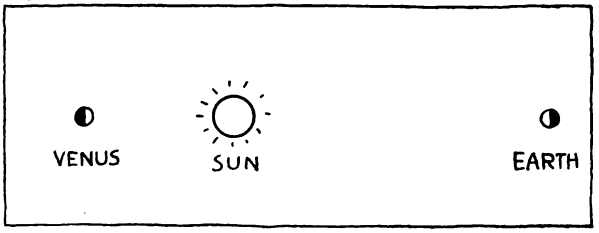
from it would shine only on the side of the ball away from me, and the side of it toward me would be dark. I couldn't see it at all."

"Do you mean to say," cried Peter, who had left his place in *Mars'* position and come nearer to Uncle Henry, "that the planets aren't like the stars? Don't they shine all the time? Don't they give light themselves?

"No," said Uncle Henry, "the planets shine only where the sunlight hits them. They are dark bodies like the moon. You remember how the moon was at 'new moon' position? Well, that's the way the Venus-ball in Betty's hand is now. I see only its dark side. Of course if *Venus* should get *right* exactly in line with the sun, as it sometimes does, we could see it as a black dot crossing the face of the sun, but not otherwise."

Then Uncle Henry explained that when the almanac says, "Venus will be in *inferor conjunction*" on a certain day, it simply means that *Venus* will then be in line with the sun and the earth and between them. Sometimes almanacs don't say "conjunction" in words, but use a little mark like this that means conjunction: ☌

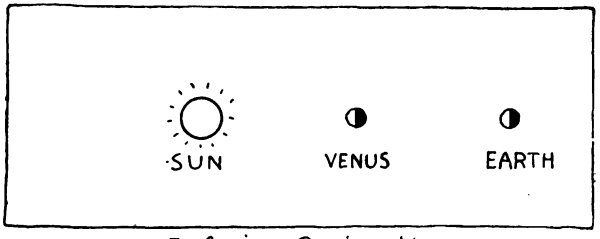
If the almanac says "*Venus in superior conjunction*" it means that Venus will be in line with the earth and sun, but on the opposite or far side of the sun. Here are two little drawings that show the position of *Venus*, the sun, and the earth at both times when they are in line.



Superior Conjunction

Marks in Almanac:

☌ ☿ ☉ *superior*



Inferior Conjunction

Marks in Almanac:

☌ ☿ ☉ *inferior*

"What are those other two little marks, beside the conjunction mark?" asked Betty.

"The first one," said Uncle Henry, "is a crude drawing of *Venus*' hand mirror in which she admires herself. It always stands for *Venus* in almanacs. The other, the circle with a dot in it, always stands for the sun. The three little signs followed by the word 'superior' mean, 'superior conjunction of *Venus* and the sun.'"

When the children understood all about this, Uncle Henry said,

"Now, Betty, while you keep the tapeline from the 'sun-melon' tight, move away from me toward the right. Move around the 'sun-melon' the opposite way the hands of a watch do. That's right. Now hold up the ball over your head again and we'll imagine the melon over there gives bright light like the sun."

"Oh," cried Paul, "I begin to see what is going to happen. It's going to act just the way the moon did."

"Fine!" said Uncle Henry enthusiastically, "you go on and tell what will happen, Paul."

"Well," said Paul, "the ball in Betty's hand will show Uncle Henry's 'Optick Brothers' more and more of its lighted side as she moves in the Venus-path from the near side to the far side of the sun. When she gets directly opposite to Uncle Henry the Venus-ball will be 'full' like the full moon. When she is only a quarter way around, the Venus-ball will be 'half-full' and when Betty is just starting away from the part of her path nearest to 'Uncle Henry Earth' the ball will show a crescent like the young moon."

"But why," called Betty, "can't we *see* the crescent-Venus and full-Venus the way we do the crescent and full moon?"

"Just because Venus is too far away from our unaided eyes. When you go to the theatre, and sit

away back in the top balcony, you can see the face of an actor, but you need an opera glass to see the expression on his face. Just so you need a small telescope to show the 'phases' or expressions of the face of *Venus*. Here is the way they look through a telescope."

Uncle Henry drew a little book from his pocket and showed the children this picture.

"Is the 'full-Venus' smaller because she is so far away then, on the other side of her path around Old Sol?" asked Peter.

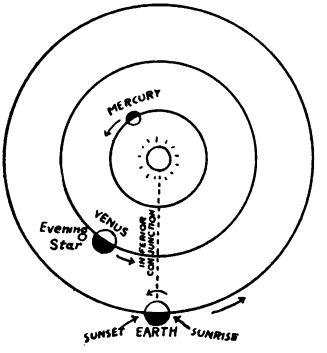
"That's it," answered Uncle Henry, "*Venus* is 134 million miles farther away from the earth when she is full than when her face looks like a little crescent moon."

"I'd like to know," said Paul, "why *Venus* is sometimes the evening star in the West and why she sometimes goes away entirely."

"*Venus* doesn't go away entirely for very long," said Uncle Henry, "only for a few days while she is in line with the earth and the sun—in 'conjunction'

you know. After that you would see *Venus* in the morning sky before sunrise, if you got up early and looked for her. For a long time the ancient people who lived thousands of years ago thought that the 'morning star' and the 'evening star' were two different planets. They named the morning star '*Phosphorus*' and the evening star '*Hesperus*,' but they finally found out that they were both *Venus*. They discovered, you see, that Venus simply passed in front of or behind the sun when she stopped being an evening star, and appeared on the other side of the sun as a morning star. These little drawings will help you see how this happens."

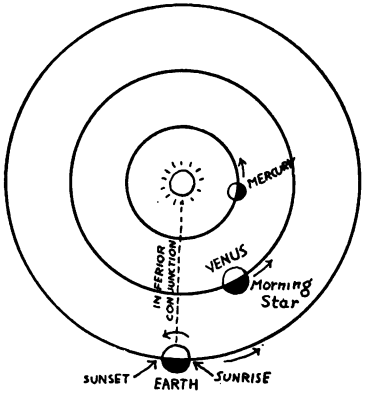
Uncle Henry then took out the notebook he always carried in his pocket and made the children these moving pictures, showing how Venus is an evening star part of the time and a morning star the other part.



When *Venus* is at the left of the dotted line joining the earth and the sun, she is seen in the West at sunset as an evening star. When approaching "inferior conjunction" she is very bright and shows a crescent through a telescope like this:

Photograph taken by E. E. Barnard, of the Yerkes Observatory, with the Bruce telescope.

But when *Venus* has passed to the right of the line, past "inferior conjunction," she is seen in the East before sunrise as a morning star.



"You see," said Uncle Henry, "sunrise and sunset aren't things that happen once every day and then are over and done with. There is both a sunrise and a sunset going on every minute. Sunrise is constantly happening at the line where the surface of the earth comes out of shadow in turning *toward* the sun; and sunset is constantly occurring on the opposite side of the world, where the surface of it is turning *away* from the sun and entering the shadow we call night."

"Isn't that wonderful?" cried Paul. "If I was a poet I would write a poem about it."

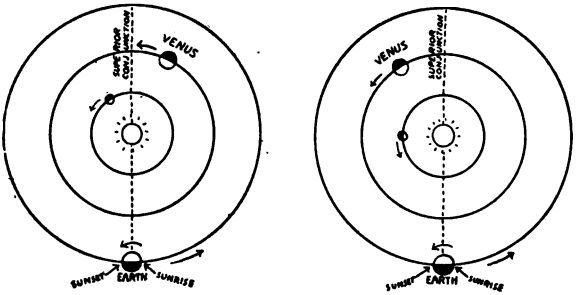
"The right poet could write a good one," said Uncle Henry. "Well, as I started to say, when Grandfather's farm gets to the place where it passes out of the sunlit side of the world, around into the shadow side, we see *Venus* in the Western sky, if she happens to be East of the sun.

"*Venus* is also seen as both a morning and evening star when she is in the part of her path that is on the opposite side of the sun. These two little diagrams show how she is a morning star up to the time she passes through 'superior conjunction,' behind the sun, and how she becomes an evening star right away afterwards.

"*Venus* isn't so bright *then*, I suppose?" said Paul.

"Quite right," Uncle Henry agreed. "Not so bright because she is farther away."

"Well, what is *Mercury* doing all this time?" asked Peter. "He has a path around the sun too, hasn't he?"



"Yes," said Uncle Henry, "and *Mercury* becomes a morning and evening star too—much oftener than *Venus* does in fact—for it takes him only 88 days to go completely around the sun, while *Venus* takes 225 days for the trip. You know how long it takes us on the earth."

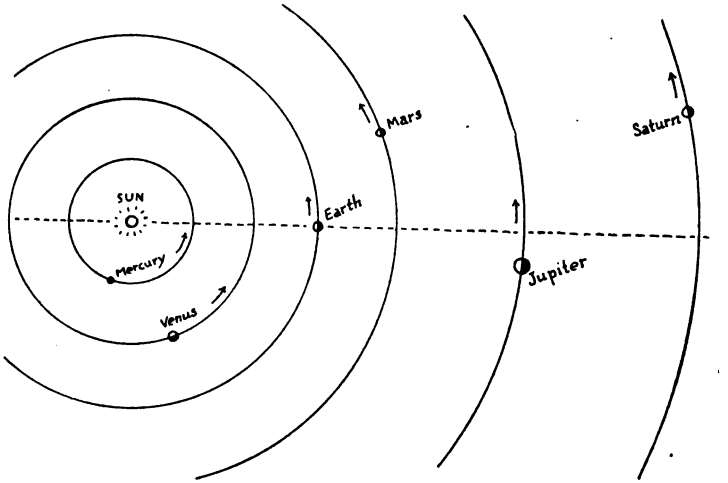
"Three hundred and sixty-five!" the children answered in chorus.

"Three hundred and sixty-five and a quarter, to be exact," said Uncle Henry.

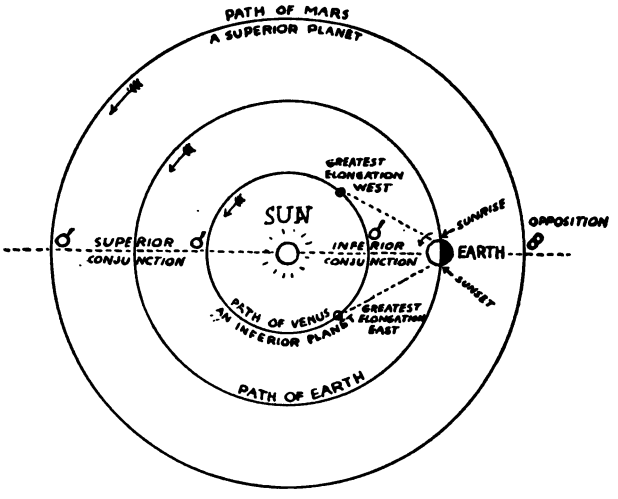
"Now tell us about *Mars*," commanded Peter, "does *Mars* have conjunctions and phases too?"

"No," said Uncle Henry, "not in the same way. *Mars*' path round the sun is outside of ours, and that makes an important difference. *Mercury* and *Venus* are called 'inferior planets' because their paths are inside that of the earth. *Mars* and all the rest of Old Sol's children are called 'superior planets' because their paths are outside of the earth's. A picture will show you the differences at once."

Uncle Henry then made this diagram in his note-book.



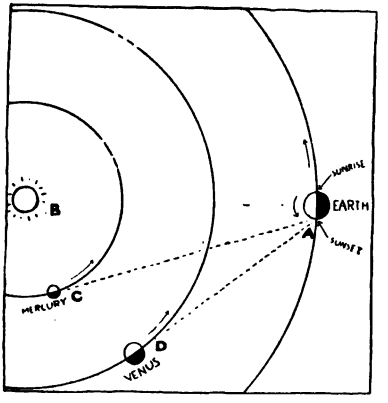
"You can easily see," explained Uncle Henry, "that since the paths of *Mars*, *Jupiter*, and *Saturn* are outside of the earth's, they can never have 'inferior conjunctions' for they never pass between the earth and the sun. When any one of the superior planets, *Mars*, *Jupiter*, *Saturn*, *Uranus*, or *Neptune*, gets in line with the earth on the *same* side of the sun we say it is 'in opposition' to the earth. The mark for 'opposition' in the almanac is like this: ☍. This picture will show all these things better than words."



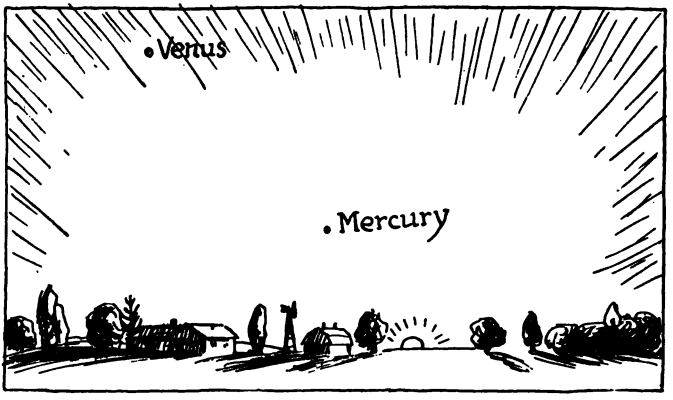
Uncle Henry then showed the children, with the help of this diagram, that *Venus* never gets more than halfway up the sky from the horizon to the overhead point, either as a morning or an evening star. When she is at her highest point in the Eastern morning sky, she is at the position in her path marked "greatest elongation West." In the same way, Venus is at the point in her path marked, "Greatest elongation East" when she is at her highest point in the Western sky, in the evening after sunset. The same things are true of *Mercury*, except that he never gets much over a fifth of the way up the sky from the horizon to the overhead point. This is true because his path is so much smaller than that of *Venus*. An inferior planet is never seen directly

overhead, but the superior planets, *Mars*, *Jupiter*, *Saturn*, and so on, can be seen at any height in the sky.

Here are two little pictures that show why *Mercury* is never seen much over one-fifth of the way up the sky, and *Venus* not over half the way up.



If you could look at the sunset sky, when both *Mercury* and *Venus* are at "greatest elongation East," you would see the sun along the line AB, *Mercury* along the line AC, and *Venus* along the line AD. The sky would then look to you like the next picture with *Venus* much over twice as high up as *Mercury*. As a matter of fact, *Mercury* is very hard to see, because he is always so close to the sun that the sunset glow drowns out his light, and when the sun has been down long enough for the sky to get sufficiently dark so we can see *Mercury*, why *Mercury* has just about gone down behind the horizon himself!



When the children said they understood all these actions of Old Sol's children it was already after dinner time, so the meeting adjourned with Uncle Henry's promise to take them all to a "movie-show" in the evening.

"But," said Betty, "there isn't any movie, not unless we go to town, and that's six miles!"

"Uncle Hen means Mr. Puck's movies—on the spider web in the barn," cried Paul. "*Thinking* of pictures, you know, and watching 'em appear on the spider web screen."

"Oh, goody!" cried Betty, "and I *do* hope Puck'll be there!"

"Me, too!" agreed Paul. "Let's think up some questions this afternoon that we can't answer ourselves, so he'll just *have* to bring the answers."

Then the children decided in favor of dinner, and fishing in the creek afterwards.

SEVENTH REEL

IN WHICH BETTY FINDS OUT HOW MUCH CAN BE TOLD WITHOUT WORDS—AND WE GET BETTER ACQUAINTED WITH OLD SOL'S CHILDREN AND GRANDCHILDREN

THE sun wasn't even out of sight when Uncle Henry and the three children met in the barn after supper. Mr. Puck's movies weren't like ordinary ones, so it didn't matter that it wasn't dark yet in the barn.

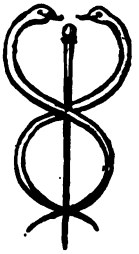
Peter and Paul put a board across two low sawhorses for the audience to sit on and they were ready to begin. The big spider web screen in the corner behind the feed box was right in front of the audience, ready to begin too.

Betty looked around eagerly for Puck, but he was nowhere to be seen.

Uncle Henry looked quietly at the screen—thinking a picture in his mind, and in a moment it began to appear dimly on the dusty, spider-woven screen.

The picture was such a queer shape that none of the children could make it out at all. It was a funny-looking symbol or emblem like this:

While the children were wondering what it could possibly be the symbol began to change. Heads appeared on the ends of the curved lines and a stick appeared between them. Finally they became snakes, like this:



"Oh," cried Paul, "I've seen something like that before. Why, it was on the uniform Uncle Henry wore during the war."

"Yes," said Peter, "and Uncle Henry was in the Medical Corps. That thing means that the soldier who wears it is in the Medical Service."

"Quite right," said Uncle Henry, "it is used as a doctor's emblem everywhere, and has been for a long time. Now see if you can tell who owned the emblem of physicians among the ancient people."

Then the rod with the snakes began to get smaller and smaller on the spider web screen, and a figure of a man began to appear. When he had become really clear he had the stick with the snakes in his hand, and the children saw that he had wings on his feet and on his cap, like this:

"Why, that's the flying *Mercury* we have on the hall table at home!" exclaimed Paul.

"Yes," said Uncle Henry, "and if you look in the almanac you will find that the little symbol we saw first is always used to stand for *Mercury*, the planet. The little mark is still called by its Latin name, which is '*caduceus*.'"

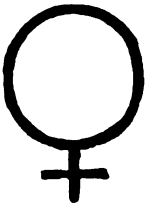
"What is the mark that stands for beautiful *Venus*, Uncle Henry?" asked Betty.

"What is it that every woman likes to use if she is beautiful?" asked Uncle Henry in return.

"A mirror!" exclaimed Betty promptly.

"Righto!" laughed Uncle Henry, "well, watch the screen for it."

The children all watched, and in a moment this little drawing appeared.



"Is that *Venus*' emblem in the almanac?"asked Paul.

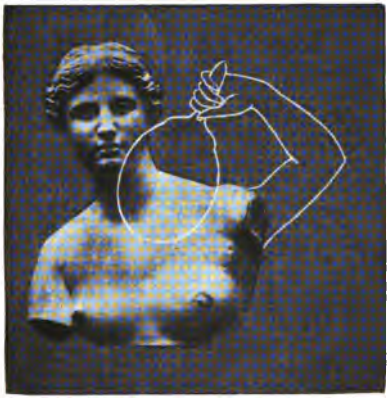
"Yes," said Uncle Henry. "Watch the screen again and you'll see how easy it is to turn our symbol of Venus into her mirror and back again."

The children did, while the mirror-symbol turned into a real hand mirror, like this:

Then the mirror got smaller, while a woman's figure slowly appeared. When she was clear she was the Venus de Milo, with a mirror in her hand.

That's how she looked before she lost her arm,"

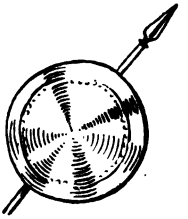
said Uncle Henry. "At least, that is how some people think she looked."



"*Mars* is next!" cried Peter.

The *Venus* was already fading out on the screen and when it had entirely gone another almanac symbol began to appear. It looked like this:

Then, as before, the outlines slowly dissolved and the picture gradually changed into a picture of a shield and a spear, like this:



"*Mars* was the God of War, wasn't he?" asked Betty.

"Sure," said Peter, "anybody knows that! Look at his shield and spear."

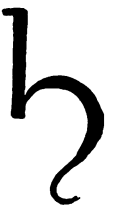
"Well, I think he's horrid! I don't want to see him. I'm going to shut my eyes if he appears."

Uncle Henry said nothing, but kept on thinking pictures, and in a moment a very strange-looking symbol appeared on the spider web in place of *Mars'* shield and spear. It was sort of a figure 4, like this:

What could it be? The children were puzzled until the figure 4 began gradually to take the shape of a bird. In a moment more it had turned into an eagle, with his beak toward the left, like this:

"The eagle," said Uncle Henry, "was the particular favorite of *Jupiter*, the chief of the Greek Gods, so the almanac uses the symbol of the eagle to stand for *Jupiter* himself. The King of Birds for the King of Gods, you see."

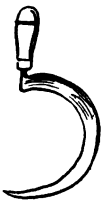
Then the eagle faded from the cobweb screen, and as soon as it was gone the next picture that Uncle Henry was thinking about started to appear. It was just as queer a shape as the figure 4 had been, and looked like this:



"It would almost be a question mark if there was a dot under it," said Peter.

"Oh, look!" cried Paul, "what it's turning into."

As the symbol faded out and the object it stood for faded in, the children recognized it just as quickly as you will.



"It's a sickle!" exclaimed Betty. "Why is it a sickle, Uncle Henry?"

"Because it stands for *Saturn*," answered Uncle Henry, "and *Saturn* was the God of the Harvest among the ancient people who named the planet for him."

"What comes next, Uncle Hen?" asked Peter.

"There are two more planets," said Uncle Henry, "and their names are *Uranus* and *Neptune*, but they are so far away and we know so little about them that if you don't mind we won't bother with them at all."

The children agreed to pass over *Uranus* and *Neptune*, just as we often pass over our very distant relatives at Christmas time.

"These five planets," said Uncle Henry, "*Mercury*, *Venus*, *Mars*, *Jupiter*, and *Saturn*, have been known and watched by people for thousands of years. It was because they moved slowly about among the other stars that people named them 'planets,' which simply means 'wanderers.' After awhile, people noticed that the planets did not move haphazard among the other stars but all followed the same path, which was named the 'zodiac.'

"It is the same path the sun takes in the daytime, so you know right away that you will never see any of the planets in a part of the sky where you have never seen the sun."

"Can't we see some 'close-ups' of Old Sol's family to-night, Uncle. Hen?" asked Paul. "You know—big pictures like the faces on the movie screen when the villain glares at the heroine."

"Oh, yes," pleaded Betty, "let's see the canals on *Mars*, an' everything."

Uncle Henry looked doubtful and shook his head.

"I've seen such pictures, Betty," he said, "but I hardly believe I remember them plainly enough to *think* them onto the spider web across so you can see them."

"Oh," cried Paul suddenly, "look! Look at the web!"

Everybody turned to look, and were astonished to see a picture forming slowly on the spider web screen.

"Oh, I know!" cried Betty, "it's Mr. Puck doing it. He's coming to help us out. It's Puck who is thinking the picture."

And so it was, for in a moment the children heard his squirrel-like laugh and there Puck sat on top of the feed box, with his long, green legs curled up under him. One moment he wasn't there at all, and next moment he was. It was astonishing the way Puck came and went, without a second's warning—just the way you think of things and forget them.

Meanwhile the picture on the spider web was

getting plainer. It was a globe, turning slowly round upon its axis, and at the north pole of it was a white spot, like this:

Photograph from Yerkes Observatory.

"It looks like the world, with all the white snow and ice at the north pole," said Paul.

"It is a world," said Uncle Henry, "but not ours. It is our little brother *Mars*, and the white cap on his head is just what you thought—a field of frozen ice and snow around the north pole. We know this because when it is Summer on *Mars* the white snow-cap melts and melts and gets smaller and smaller until it entirely disappears. It takes a telescope

at least three inches in diameter to enable you to see the polar cap on *Mars*."

Here Mr. Puck picked up a long straw from the top of the feed box and waved it across the picture like a wand. At once the white cap at the pole of *Mars* began to shrink, and get smaller and smaller until it was all gone. This moving picture shows how it happened. On *Mars* Summer is six months long, because his year is twice as long as ours.

"Sometimes," said Uncle Henry, "*Mars* is too far away to see the polar caps well, even in a powerful telescope. This is when he is on the opposite side of his path from us, near the 'superior conjunction' position we learned about. It is when *Mars* is on the same side of the sun with us that he is biggest and plainest. That is the time astronomers study the polar caps and try to see whether he really has canals or not."

This little picture on the next page shows the different sizes *Mars* appears to be when nearest, farthest away, and halfway between.

"Do *Mercury* and *Venus* wear 'polar caps' too?" asked Betty.

"No," said Uncle Henry, "there is very little to see through a telescope on either *Mercury* or *Venus*. Their changes in 'phase,' from full to crescent and back again are the main things about them."

Puck waved his wand of straw across the picture on the screen and it vanished. In its place a great globe appeared with broad stripes across it, like this:

'Now," said Uncle Henry, "you will see some of Old Sol's grandchildren. Does anybody find them in the picture?"

"I do," said Paul, "aren't those four little round dots the babies of the big round globe?"

"Yes," replied Uncle Henry, "and the big round globe is *Jupiter*, the biggest of all Old Sol's family. *Jupiter* has four little children, or moons, that can be seen easily even in a very good field glass. There are others besides, but they are so tiny it takes a

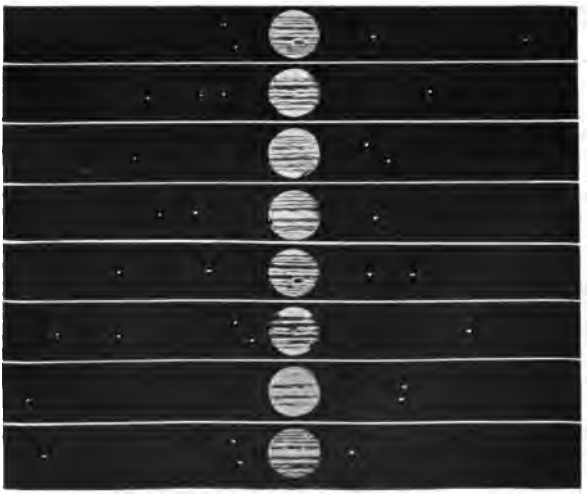
very big telescope to see them. It takes a three-inch telescope to see the belts of cloud that *Jupiter* always wears around his middle."

"Do *Jupiter's* children all have paths around him too—the way we, and *Mars*, and *Venus* have paths around our father, Old Sol?"

"Yes, that's right," agreed Uncle Henry, "and so we cannot always see four of them at once. Sometimes they get behind *Jupiter* and go out of sight."

Mr. Puck waved his straw wand over the screen again, and the moons of Jupiter began moving back and forth across the round globe. They were really going round and round *Jupiter* but they seemed just to swing back and forth like pendulums.

This is the moving Picture Mr. Puck made the children see on the cobweb screen:



"Did you ever hear of *Galileo*?" asked Uncle Henry.

The children had heard of him but didn't know anything about him.

"Old One," cried Puck suddenly to Uncle Henry, "I knew *Galileo* well. He kept me busy all his life—fetching him answers. He wished to find out everything, especially about the stars. I well remember the night he pointed the new telescope he had just invented at *Jupiter*. He gave a cry of joy and sat up all night, looking through the telescope, for he had seen what no living man had even seen before him—the moons of *Jupiter*."

Puck waved the straw wand once more. The little moon-children of *Jupiter* the giant planet, faded out, and finally belted *Jupiter* himself was gone.

The picture that came in his place had hardly become clear before Peter and Paul cried, both together,

"That's *Saturn*, and his rings!"

Saturn appeared like this on the spider's movie screen.

Photograph taken by Mr. E. E. Barnard, of the Yerkes Observatory, with the 60 inch reflecting telescope at Mount Wilson Observatory in California.

"Has *Saturn* any children, Uncle Hen?" asked Peter.

"Only eight!" smiled Uncle Henry, "—but they are all very small. Mr. Puck, will you please show us how Saturn and his eight children would look in a big telescope."

Puck again waved his wand of straw across the spider web and this picture slowly appeared.

"Are we going to see a movie of Saturn's moon-children going around him in circles too?" asked Betty eagerly.

"It would be just about like the movie of Jupiter," said Uncle Henry. "Shall we show it to them, Mr. Puck—or make them imagine it for themselves?"

"Locked doors need keys but once, Old One." said Mr. Puck mysteriously.

The children didn't know what he meant until the next picture had become clear on the screen. It was a picture of Betty herself.

Then Paul appeared, walking round her in a circle. In his hand he held a big humming top, like this:

Paul held the humming top so that its handle, or axis, slanted just about the same as the axis of the geography globe does.

As he walked around Betty in a circle, the moving picture of Paul on the screen kept the handle of the humming top always slanted in the same direction.

When the Betty in the picture looked at the humming top in this position, the axis, or handle, was tipped toward her, and she could see the upper side of the top, like this:

But when Paul had walked a quarter way round the circle into this position—

—the top looked like this from Betty's place at the center of the circle:

Then the Paul in the picture went a quarter of the way farther round so that the top was in this position—

—and the Betty in the picture could see the bottom side of the humming top, like this:

When the Paul in the moving picture had walked three-quarters of the way round the circle, still holding the handle of the top slanting in the same direction, the two picture-children and the top looked like this—

—and Betty in the picture again saw the edge of the humming top as a straight line, without seeing any more of the upper part of the top than she did of its bottom part.

When the Paul in the picture had walked the rest of the way round his path, the humming top looked just the same to Betty in the picture as it did when Paul started to carry it around her.

"Now you know," said Uncle Henry, "how the rings of *Saturn* change their appearance to people on our earth while *Saturn* is traveling in his path around the sun. It takes him twenty-nine and one-half years to do it, so when we look through a telescope, and see *Saturn* looking as the humming top did in the first picture—

—we know that in about seven years, when *Saturn* is a quarter way round his path, he will look as the humming top did in the second picture.

"Then in about seven years more we can expect *Saturn* to look as the humming top did when Betty could see the underside of it.

"Then, of course, in about seven years more, *Saturn* will again show us only the edge of his rings, and when he has completed his journey round the sun the upper side of the rings will again be visible, as they were when his trip started."

Here is a moving picture of the way *Saturn* looks from the earth through one whole trip around the sun. The dates beside the pictures show how he will look for quite a long time to come too.

"So that's all of Old Sol's family we are going to see?" asked Paul, as the last picture faded from the spider web and the children noticed that the barn was almost dark.

"There is very little known about *Uranus* and *Neptune*, our most distant relatives," said Uncle Henry, "and nothing as interesting to see as the white cap *Mars* wears.

"Mr. Puck," he asked of the little green man, "have you any more moving pictures on the program of this theatre to-night?'

There was no answer, and when the children and Uncle Henry peered through the dusk there was no Mr. Puck to be seen.

Just then, however, Betty noticed a faint glow on the spider web, and as it grew in brightness the audience read these words, Puck's parting message,

> "When I undertake to tell the best I find I cannot, . . I become a dumb man." *

* Walt Whitman: "A Song of the Rolling Earth."